THREE ESSAYS ON TIME AND DEVELOPMENT ECONOMICS

By

LUSEKELO GEORGE MWANDONDWA

DISSERTATION

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

DOCTOR OF PHILOSOPHY

IN DEVELOPMENT POLICY

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The committee in charge:

Professor Joshua Merfeld

Professor Sungho Park

Professor Inbok Rhee

Professor Dongil Lee

Professor Joeun Kim

Approval as of November, 2023

ABSTRACT

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This dissertation covers topics on time allocation and development economics. Chapter 1 examines professional development (PD) training as a mechanism for bridging achievement gaps both among teachers and among pupils. Employing a difference-in-differences approach, I find that PD training allowed both teachers and students with low performance to bridge the achievement gap. Chapter 2 focuses on analyzing how the satisfaction of both leaders and subordinates relate to the competence and work behaviors of subordinates. The findings reveal that both the satisfaction of leaders and subordinates are significant for professional competence and working behaviors of subordinates. These findings underscore that leader and subordinate satisfaction are not substitutable but rather complement each other in shaping competence and work-related behaviors within an organization. Chapter 3 unpacks the patterns and heterogeneity in the allocation of time to market work, household production, as well as leisure and relaxation activities, with a specific focus on the life cycle of both children and individuals. Through descriptive analysis of American Time Use Survey data spanning from 2003 to 2021, I unveil that time use pattern and heterogeneity evolve throughout the child's life cycle and individual's stages of life. For instance, bachelor's degree (BA) holders allocate more time to work-related activities than non-BA holders, with the gap increasing as the child grows from infancy to age 17. However, they allocate less time on socializing and leisure compared to non-BA holders. The findings of this study provide valuable insights for policymakers, employers, and individuals striving for a more balanced and productive life.

Keywords: *Achievement Gap, Professional Development, Job Satisfaction, Time Use, Lifecycle*

Dedicated to:

My beloved parents,

Neema Mwatebela and

George Mwandondwa

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This academic journey has been a testament to my dedication, perseverance, and commitment to expanding knowledge in my field. I am eternally grateful to Almighty God for providing me with the strength, resilience, and guidance throughout this academic journey. I would like to extend my sincere appreciation to my supervisor, Professor Joshua Merfeld, for his unwavering guidance, patience, and scholarly insights throughout my research journey. I am also grateful to my dissertation committee members, Professors Sungho Park, Joeun Kim, Inbok Rhee, and Dongil Lee, for their valuable insights, constructive feedback, and the time they dedicated to reviewing and advising on my work. I would like to acknowledge the immeasurable support, prayers, love, and encouragement from my family throughout this academic journey. I extend my heartfelt thanks to my Ph.D. colleagues, whose camaraderie, shared knowledge, and collaborative spirit have made this academic pursuit not only productive but also enjoyable. I extend my thanks to KDI School of Public Policy and Management, for providing an enriching academic environment and resources that have enabled me to explore and expand my academic horizons. Last but not least, I am grateful to the Ministry of Finance of Tanzania for their continued support and for granting me the study leave that made this Ph.D. journey possible.

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LIST OF ABBREVIATIONS

Abbreviation	Definition
BA	Bachelor's Degree
ATUS	American Time Use Survey
DFID	Department for International Development
DID	Difference-in-differences
EQUIP-T	Education Quality Improvement Program in Tanzania
LGAs	Local Government Authorities
LSDV	Least Squares Dummy Variable
MoEC	Ministry of Education and Culture
OECD	Organization for Economic Cooperation and Development
PD	Professional Development
PSM	Propensity Score Matching
URT	United Republic of Tanzania
WB	World Bank
WEC	Ward Education Coordinator

CHAPTER ONE

Closing Achievement Gaps:

The Potential of Professional Development Training to Teachers

Abstract

One of the most essential tools for improving student learning and academic achievements is teachers' professional development (PD) training. In contrast to existing studies, this study examines PD training as a mechanism for bridging achievement gaps both among teachers and among pupils. This study utilizes data from the Education Quality Improvement Program in Tanzania (EQUIP-T) for the years 2014, 2016, and 2018. Employing a difference-in-differences approach, I find that PD training allowed male teachers to bridge the achievement gap with female teachers in terms of improving student performance. The training also enabled male students to bridge achievement gaps with female counterparts in mathematics and Kiswahili subjects. Similarly, students from disadvantaged backgrounds bridged the achievement gap with those from advantaged backgrounds in both subjects. Therefore, high-quality instruction and relevant pedagogical techniques provided by PD training are critical for narrowing achievement gaps.

Keywords: *Achievement Gap, Professional Development, Teachers, Students, DID, EQUIP-T*

1.1. Introduction

Student achievement has emerged as a crucial metric for judging the quality of education systems (Chapman & Adams, 2002). To be able to improve student learning and achievements, teachers' professional capacity and performance must be improved. That is, teachers require relevant and sufficient training to improve their teaching practices and thereby ensure that students acquire relevant and high-quality training and instructions. Providing teachers with professional development training is one of the ways of improving their pedagogical skills and knowledge on the subject contents, among other things. Succinctly, the notion that professional development (PD) training can help teachers improve and subsequently raise students' academic achievement is widely acknowledged. This is because professional development training is based on several views and theories about how students and teachers learn (Kennedy, 2016).

A substantial number of teachers in developing nations are inadequately prepared to teach and lack the knowledge and capabilities necessary for enhancing student learning and achievement (Bold et al., 2017; Tandon & Fukao, 2015; Bruns & Luque, 2015). Having a high level of education is not a panacea for improving teachers' performance and student achievements. Several studies (see, for example, Bold et al., 2017; Bruns & Luque, 2015) attest to the fact that many teachers have poor cognitive skills and classroom practices, despite having a high level of formal education. This lowers the quality of education offered to students. Tanzania is no exception; studies reveal that education quality, particularly in primary schools, is low (MoEC, 2001; DFID 1999). One explanation for this is that most Tanzanian teachers have a low level of subject-matter expertise and are pedagogically inadequate (Katera & Msafiri, 2020). To enhance the quality of primary school education, Tanzania established the

Education Quality Improvement Program in Tanzania (EQUIP-T). The program aimed, among other things, to improve teachers' subject knowledge, pedagogical abilities, and teaching attitudes to enhance their professional competence and performance (Pettersson et al., 2015).

In contrast to existing studies, my study examines PD training as a mechanism to assist both teachers and students in bridging achievement gaps. Existing studies have primarily focused on the heterogeneous impact of PD training (Rawle 2020; Rawle et al., 2019) and the overall impact of such training on students' performance (Gore et al., 2021; Didion et al., 2020; Egert et al., 2018; Bressoux et al., 2009; Jacob & Lefgren, 2004). The central question in this study is, therefore, 'Can professional development training serve as a mechanism for bridging achievement gaps for teachers and students with low performance?' To address this question, I first compare the effects of male and female trained teachers on students' performance in the pre- and post-treatment periods. Second, I compare the impact of teachers' PD training on male and female pupils' performance before and after the intervention. Lastly, I compare the impact of the treatment on students from disadvantaged and advantaged backgrounds before and after the treatment.

This paper provides empirical evidence regarding the impact of professional development (PD) training on the closing of achievement gaps between teachers and between students. PD training has the potential to bridge achievement disparities among teachers with different performance levels. This is because such training improves teachers' subject knowledge and pedagogical techniques (Dadds, 2001; Lavy, 2001). This implies that even though professional development training affects all teachers in general, it primarily provides an opportunity for teachers who lack in-depth subject-matter expertise or employ less effective teaching practices to bridge the performance gap. Similarly, academic achievement of students

varies based on factors such as gender (Aucejo et al., 2020) and family background (Buckhalt, 2011). The increase in teacher productivity and teaching quality due to PD training benefits all students, but it is particularly advantageous for those with lower academic achievement, such as students from disadvantaged families.

The first motivation behind this study is the poor quality of primary education in Tanzania because of ineffective teaching strategies and a shortage of teachers with in-depth subject matter knowledge. However, not all pupils are equally impacted by the poor education in schools. For instance, students from disadvantaged backgrounds, such as those with many siblings aged 0 to 17, often experience a disproportionately modest distribution of family resources and eventually poorer educational investments, and less parental involvement in their education. This is consistent with Becker's (1964) contention that disadvantaged families are often not able to make enough educational investments for their children. Similarly, when compared to elementary pupils from non-poor households, pupils from poor households fare worse in reading and mathematics (Bentzel, 2012). In addition, pupils from low-income households are less likely to complete a grade and have poorer standardized test results (Buckhalt, 2011). Furthermore, students with literate mothers often outperform those with illiterate mothers. This occurs because illiterate mothers have less success than literate ones in imparting the cognitive language skills necessary for their children's early academic achievement (Benjamin, 1993).

Second, the effectiveness of teachers in boosting students' performance determines the quality of education (Roberts & Dyer, 2004). In other words, differences in teacher effectiveness may lead to variations in student achievement. Several studies have revealed that male teachers are less effective than female teachers in influencing students' academic

achievements. For instance, Hwang and Fitzpatrick (2021) found that female teachers are more effective at enhancing the academic achievements of students, irrespective of gender, in elementary and middle schools. A similar study conducted by Krieg (2005) on fourth graders revealed that students instructed by female teachers outperformed their peers instructed by male teachers. Additionally, female teachers tend to be more intrinsically motivated to teach compared to their male counterparts, resulting in better performance (Mkali, 2021). Saban (2003) found that the majority of female teachers in primary schools exhibit a more favorable attitude toward the teaching profession, display higher levels of commitment to teaching, and are more intrinsically and altruistically driven than their male colleagues. Moreover, female, and male teachers often employ different teaching styles (Nelson Laird et al., 2007), potentially leading to variations in student learning and performance.

Third, apart from the teacher's gender, student gender is also related to heterogeneity in student performance. For example, boys typically perform worse than girls in schools across the developed world (Legewie & DiPrete, 2012). Reardon et al. (2019) found that female students outperform male students in reading, but there is no indication of a gender gap in academic achievement for mathematics. Likewise, Fortin et al. (2015) revealed that the gender gap in academic achievements is widening in favor of females in United States high schools. Several other studies support the finding that girls tend to have better educational outcomes compared to boys (i.e., Aucejo et al., 2020; Freeman, 2004; Jacob, 2002). The situation in which male students are outperformed by their female counterparts across a range of significant educational outcomes has been referred to as the "silent gender gap" (Riordan, 1999).

This study employs data sourced from the Education Quality Improvement Program in Tanzania (EQUIP-T) covering the years 2014, 2016, and 2018. The survey encompasses a

comprehensive dataset comprising time-varying factors associated with students, teachers, and schools, in addition to fixed effects at the regional, district, and school levels. It encompasses data on PD training, students' family backgrounds, and their scores in mathematics and Kiswahili. The data collectors (i.e., Oxford Policy Management) employed the propensity score matching (PSM) approach to match eligible control schools with the sample of treatment schools. The treatment schools were selected using stratified systematic random sampling. To attain the study's objectives, I employed the difference-in-difference estimator, accounting for pre- and post-treatment heterogeneity.

The findings of this paper show that PD training opens the door for the teachers and students with low performance to close the performance gaps. It assists male students in closing the achievement gaps with female students in mathematics and Kiswahili subjects. These training also assist male teachers in closing the achievement gaps with female teachers in terms of improving student performance. Finally, PD training allows students from disadvantaged backgrounds to close the achievement gaps with those from advantaged backgrounds. This study's findings offer numerous significant contributions to the existing literature. Firstly, it contributes to the growing body of research examining the impact of professional development (PD) training on teaching quality. Secondly, it enriches the literature on how PD training impacts students' academic performance. Lastly, it extends the scope of knowledge regarding the heterogeneity of effects associated with PD training.

This paper is closely related to the EQUIP-T impact evaluation study conducted by Ruddle and Rawle (2020) and Rawle et al. (2019). These papers examined heterogeneity in student performance based on gender and poverty. In contrast, I focus on comparing pre- and post-treatment heterogeneity to assess PD training as a potential mechanism for closing

achievement gaps. Additionally, I investigate heterogeneity based on mothers' literacy and the number of children aged 0 to 17 in households, which Ruddle and Rawle (2020), Rawle et al. (2019), and previous PD training studies have not explored. This paper is also related to several studies that have investigated the impact of teacher training on students' performance (Gore et al., 2021; Didion et al., 2020; Bressoux et al., 2009). These papers, however, did not focus on assessing PD training as a mechanism to assist teachers and students with low performance to bridge the achievement gaps. That is, while there may be heterogeneity in post-treatment performance, there may also be heterogeneity in the pre-treatment period. If the heterogeneity before the treatment is reversed or narrowed after treatment, it may imply that the achievement gap is closing or narrowing.

The rest of the paper is structured as follows. First, it provides an overview of the EQUIP-T program along with the link between professional development and student accomplishment. Secondly, it provides highlights of the study's data and conceptual framework. Finally, it discusses the identification strategy, findings of the study, and draws a conclusion.

1.2. EQUIP-T and Teacher Professional Development

1.2.1. Education Quality Improvement Program in Tanzania (EQUIP-T)

Primary education is the only type of education that is guaranteed to everyone in Tanzania. According to URT (2012), primary education equips children with the skills necessary for self-advancement, self-initiative, and self-confidence, as well as preparing them for the workforce. Education has always been considered as a pillar of national progress since the country's independence in 1961 (Chonjo, 2018). For instance, the new Education and Training Policy vision is to produce “An educated Tanzanian with the requisite knowledge, skills, ability and positive attitude that add value in national development” (URT, 2018).

However, providing every child with access to high quality education was one of the Tanzania's top challenges since 1970s (Kuleana, 1999). That is, for a long time, many primary schools in Tanzania have been plagued with concerns about the quality of the education they offer (MoEC, 2001; DFID, 1999). Even recent reports show that this problem still exists. For example, URT (2018) reports that there is still growing concern regarding education quality, which is reflected in the poor learning outcomes.

The quality of the teachers plays a vital role in shaping students' learning and academic achievements in developing countries (Heyneman & Loxley, 1983). The impact of teachers' quality on student accomplishment appears to increase with a nation's level of poverty (Solmon, 1985; Chonjo, 2018). Tanzanian teachers possess low level of subject-matter expertise, claim Katera and Msafiri (2020). Their study reveals that while teachers' performance in mathematics was comparatively better, it was not satisfactory in English and even pedagogically inadequate. This raises concerns about teachers' capacity to impart knowledge to students, signaling a subpar delivery of necessary information and instruction (Katera & Msafiri, 2020). To improve education quality in public primary schools and pupils' learning outcomes in Tanzania, the government of Tanzania established Education Quality Improvement Program in Tanzania (EQUIP-T).

Education quality improvement program in Tanzania (EQUIP-T) was a 6 years (2014-20) program. It was sponsored by the Department for International Development (DFID) of the United Kingdom and managed by Oxford Policy Management (Ruddle & Rawle, 2020). To enhance the education quality in public primary schools and learning outcomes of pupils in Tanzania, the program targeted regions which are most disadvantaged in terms of education.

The program covered 9 regions, 5,192 public primary schools, 3,155,789 pupils and 56,139 teachers, 63 Local Government Authorities (LGAs) and 1,320 wards (Ruddle & Rawle, 2020).

EQUIP-T comprises four key components. The first component focused on enhancing teacher performance, aiming to address various impediments to effective teaching, including deficiencies in subject knowledge, pedagogical shortcomings, and low teacher morale. This component encompassed various interventions. One of these interventions involved creating a competency framework that outlines the level and type of competencies required by teachers. Another intervention was a school-based in-service training for 49,000 teachers focusing on self-directed learning, practical application, and demonstration. Managing teacher performance constituted another intervention, entailing the establishment of performance targets, criteria, and appraisal mechanisms for 49,000 teachers. Component 1 also entailed the creation of a toolkit designed to enhance the morale of 49,000 instructors. Similarly, a 16-week school readiness program was initiated to provide teaching assistants with the necessary training and resources. Furthermore, scholarships were awarded to promising lower secondary graduates, particularly girls from rural areas, with the goal of enabling them to return to their rural communities and serve as teachers.

The second component of EQUIP-T centered on enhancing the leadership and management of schools. This component was designed to tackle various challenges associated with school administration and leadership. It aimed at addressing issues such as inadequate school planning, deficient oversight, budgeting shortcomings, and suboptimal human resource management by headteachers. The primary objectives of this component were to promote school accountability, and maximize efficiency and effectiveness in delivering relevant, high-quality education with the available resources. The key initiatives within this component

included the creation of a school quality framework, serving as the cornerstone for comprehensive school planning. Similarly, to enhance the utilization of data and analysis for school planning, monitoring, and evaluation, a school information system (SIS) was established. Additionally, headteachers received training in data collection, analysis, and utilization. Moreover, this component encompassed the development of a performance management system to enhance school leadership and overall performance.

The third component focused on district planning and administration, aiming to establish systems and enhance the capacity of human resources for effective subnational education management. The last component centered on encouraging community involvement and accountability. Its objective was to empower communities to proactively enhance school outcomes and services by providing them with vital information, resources, and tools.

Among the four components, teacher in-service training (component 1) emerged as the most effective. This was primarily due to its direct association with what students learned in the classroom and its successful execution (Ruddle & Rawle, 2020). The in-service training equipped teachers with a variety of tools for classroom instruction, improved their classroom management skills, boosted teacher motivation and confidence, and resulted in greater utilization of teaching aids (Ruddle & Rawle, 2020). This positive outcome occurred because nearly all the teachers participated in some form of the training, and both the input and output met expectations. To varying degrees, the other components served as auxiliary factors.

1.2.2. Teacher Professional Development

Teacher professional development refers to organized professional learning that alters teachers' teaching methods, expands their subject matter knowledge, and enhances students' academic outcomes. It is increasingly gaining recognition as a technique to help students excel

in the subjects taught in class. Teacher professional development equips teachers with the most effective and appropriate means of teaching pupils to think critically, solve problems creatively, and communicate effectively (Darling-Hammond et al., 2017).

Theoretically, there are several ways in which professional development (PD) training improves the quality of schooling. To begin with, PD activities may enhance the quality of education by expanding teachers' knowledge and understanding of the subject (see Dadds, 2001). Similarly, by providing instructors with relevant and appropriate pedagogical methods and strategies, PD programs may improve the quality of education (see Angrist & Lavy, 2001; Schifter et al., 1999). Finally, such programs may improve education quality by assisting teachers in developing a good attitude toward teaching (Cobb, 2000).

The quality of teaching plays a pivotal role in shaping the educational outcomes of both advantaged and disadvantaged students. Enhanced teacher quality exerts a substantial influence on student performance (Fryer, 2017; Rockoff, 2004). For instance, an increase in a teacher's quality corresponds with an improvement in a student's reading proficiency (Buhl-Wiggers, et al., 2017). However, as indicated by Chetty et al. (2014) and Chetty et al. (2011), in order for teacher quality to exert a substantial and enduring impact on children, both during their school years and into adulthood, it is imperative that children are exposed to high-quality teaching from an early age. Professional development (PD) programs for in-service educators is one of the effective ways to enhance teacher quality. For instance, Gore et al. (2021) argue that PD training improves the quality, motivation, and morale of teachers. Their study shows that the PD training for teachers is beneficial for students' performance in mathematics. Likewise, Bressoux et al. (2009) found that PD training enhances mathematics performance. However,

the main factor contributing to this improvement is an increase in subject matter competence rather than changes in teaching methods.

Didion et al. (2020) found that providing in-service training exerts a substantial and beneficial impact on the reading performance of students. Similarly, Blank and Alas (2009) revealed that mathematics-focused professional development training significantly influences students' learning and performance in mathematics. Additionally, Angrist and Lavy (2001) discovered that in-service training enhanced pupils' achievements in reading and mathematics. They also suggested that teacher training is a more cost-effective means of improving test scores compared to reducing class sizes or extending school hours. Moreover, Rawle et al. (2019) assessed the impact of the EQUIP-T program on the academic achievements of primary school pupils in Tanzania. Their results reveal that EQUIP-T was more beneficial for girls' performance in both Kiswahili and math. In Kiswahili, the performance of students from poor and non-poor families is similar. However, in mathematics, students from non-poor families outperform those from poor families.

On the flip side, massive investments in professional development training do not always lead to improved student learning outcomes. For instance, according to Loyalka et al. (2019), professional development and related interventions did not increase teachers' and students' outcomes in China after one year. One of the primary reasons for this phenomenon was that teachers encountered considerable difficulty in translating the highly theoretical content of professional development training into practical implementation. Similarly, Lu et al. (2019) noted that although professional development training did not yield a significant improvement in math performance or classroom teaching practices, it did have a positive impact on teachers' knowledge related to mathematics instruction.

Despite several studies in this field, it remains unclear which aspects of teacher professional development contribute to changes in practices of teachers and, consequently, improvements in students' academic performance (Kennedy, 2016; Yoon et al., 2007; Blank & Alas, 2009). Furthermore, several other studies (Lu et al., 2019; Loyalka et al., 2019; Bruns & Luque, 2015; OECD, 2009) have shown that, even though developing countries have begun investing substantial sums of money in professional development training programs, there is limited evidence to suggest that such programs are effective.

1.3. Data

This study uses data from EQUIP-T quantitative surveys. The initial survey took place in 2014, with subsequent follow-up surveys conducted in 2016 (midline) and 2018 (endline), respectively. The survey provides a rich set of data on time-varying covariates related to pupils, teachers, and schools, as well as regional, district, and school fixed effects. It includes data on in-service training, students' family backgrounds, and student scores in mathematics and Kiswahili.

The treatment group in this survey comprised 100 public primary schools from 17 districts, while the control group consisted of 100 public schools from 8 districts. The fewer districts in the control group result from matching, in which only 8 districts matched with the 17 districts in the treatment group. In this study's setting, 5,083 pupils in 100 schools are in the treatment group, receiving instruction from teachers who have undergone professional development training. In contrast, the control group consists of 5,019 pupils who are being taught by teachers without such training in another set of 100 schools. The data collectors (i.e., Oxford Policy Management) employed the propensity score matching (PSM) approach to match eligible control schools with a sample of treatment schools. This was carried out

following the process of stratified systematic random sampling to choose schools located within the treatment districts. Similarly, students were sampled within schools using a systematic random sampling approach based on school registers. Notably, all 200 schools that participated in the baseline survey also took part in the midline and endline follow-up surveys, achieving a 100% response rate.

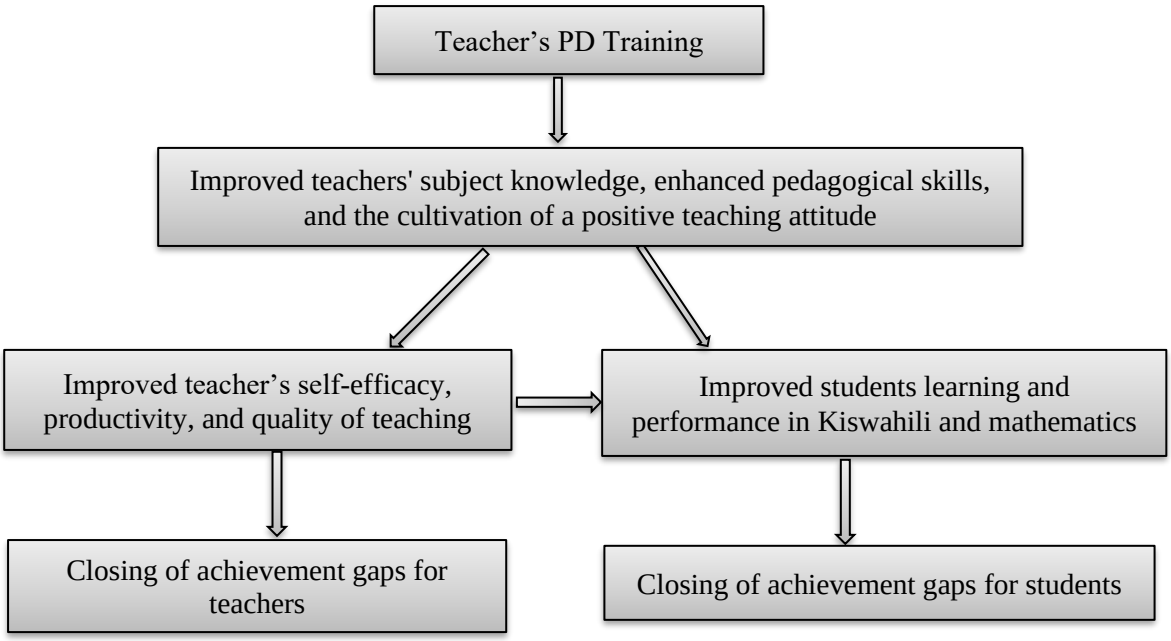
Table A 1.1 in the appendix presents the statistical summary for this dataset. It contains characteristics of pupils and their households, as well as school and teachers' characteristics. It also displays the outcomes that were employed in this study. On the other hand, within the appendix, Table A 1.2 displays the balance test results for the control and treatment groups.

1.4. Conceptual Framework

Figure 1.1 portrays the conceptual framework and the mechanism by which students' academic achievements in Kiswahili and mathematics are impacted by teachers' professional development (PD) training. The PD training helps to improve teachers' pedagogical skills (i.e., teaching skills and classroom management skills of a teacher), knowledge on the Kiswahili, as well as mathematics subjects' content, and attitude of the teacher towards teaching profession. In this context, an improvement in teachers' attitudes indicates, among other things, an increase in their interest in and sense of fulfillment from their career as well as their motivation and commitment to the teaching profession. Enhancements in teachers' proficiency within the specified domains contribute to higher teacher productivity, performance, self-efficacy, and the overall quality of their teaching. As a consequence, this results in the enhancement of student learning and performance in Kiswahili and mathematics. These advancements are pivotal in helping both teachers and pupils with lower initial performance levels to narrow the

achievement gaps. While PD training generally affects all teachers and students, its impact is more pronounced among those with lower initial performance levels.

Figure 1. 1: Conceptual Framework



Note: Teacher professional development (PD) training improves their subject knowledge, pedagogical skills, and teaching attitude. This, in turn, enhances various aspects, including teaching quality, which assists teachers with lower performance in closing achievement gaps. The enhancement of teachers' knowledge, pedagogical skills, and attitude, coupled with improved productivity and teaching quality, positively impacts student learning and performance. Consequently, this aids students with lower performance in closing achievement gaps.

1.5. Identification Strategy

The difference-in-differences (DID) approach is first utilized to estimate the overall effect of the treatment on students' performance, a key outcome of interest. In this context, DID is used to evaluate the two dimensions of contrast which are treatment (i.e., students' exposure to teachers who received training) and time (i.e., before and after). Essentially, it compares the outcome between students taught by teachers who received professional development training

and those taught by teachers who did not receive such training before and after the treatment. It is noteworthy that this setting does not consider pre- and post-treatment heterogeneity.

The DID estimate of the impact of students' exposure to teachers who received training is represented by equation (1.1).

$$\boldsymbol{Y_{it} = \beta_0 + \beta_1 Treat_{it} * Post_{it} + \beta_2 Treat_{it} + \beta_3 Post_{it} + \gamma X_{it} + \alpha_d + \rho_t + \varepsilon_{it}} \quad \textbf{(1.1)}$$

Where $\boldsymbol{Y_{it}}$ is the main outcome of interest representing the performance on Kiswahili/Mathematics for student $\boldsymbol{i}$ at time $\boldsymbol{t}$, $\boldsymbol{Treat_{it}}$ is a dummy representing whether a student is being taught by teachers who received training, $\boldsymbol{Post_{it}}$ is a dummy representing a period after the introduction of the treatment and $\boldsymbol{\beta_1}$ is a DID estimate of the impact of students' exposure to teachers who received training. $\boldsymbol{X_{it}}$ represents school characteristics (e.g., staffroom, electricity, water, number of classrooms, and library), student characteristics (e.g., age and gender), student household characteristics (e.g., household size, number of siblings aged 0 – 17, mother's literacy, poverty status, household asset ownership, and housing characteristics), teacher characteristics (e.g., gender), teacher rewards, teacher satisfaction, and headteacher satisfaction. α_d represents the district fixed effects while ρ_t represents the year fixed effect. $\boldsymbol{\varepsilon_{it}}$ is the error term. The standard errors are clustered at the school level.

Second, the difference-in-difference estimator, accounting for pre- and post-treatment heterogeneity, is used. This setting is the main focus of this study. Equation (1.2) provides a DID estimate of the impact of professional development (PD) training on narrowing/closing achievement gaps. This DID design helps illustrate performance heterogeneity both before and after treatment for both teachers and pupils. The assessment of heterogeneity encompasses factors such as gender for both teachers and students, as well as students' family background.

$$Y_{ist} = \beta_0 + \beta_1 Treat_{ist} * S_{ist} * Post_{ist} + \beta_2 Treat_{ist} * S_{ist} + \beta_3 Treat_{ist} * Post_{ist} + \beta_4 S_{ist} * Post_{ist} + \beta_5 Treat_{ist} + \beta_6 S_{ist} + \beta_7 Post_{ist} + \gamma X_{ist} + \alpha_d + \rho_t + \varepsilon_{ist} \quad (1.2)$$

Where Y_{ist} is the outcome variable representing the performance on Kiswahili/Mathematics for student i in category s at time t. There are two categories for students: gender (i.e., female versus male) and family background such as poverty, mother's literacy, and number of siblings. Similarly, the analysis for teachers is based on only one category, which is gender. Therefore, S_{ist} is a dummy representing the category of student (i.e., gender, poverty, number of siblings aged 0-17 and mothers' literacy) as well as the category of teacher (i.e., gender). The parameters of interest are $\beta_1$and β_2. The study involves comparing β_2 which is the estimated performance of individual in category s in the pre-treatment period to $\beta_1$which is the estimated performance of individual in category s after the introduction of the treatment. Comparing these two estimates is crucial for seeing the impact of the treatment on the closing or narrowing of achievement gaps.

The key identification assumption in this study is that time trends in control and treatment schools were the same in the pre-intervention period. To test this, I employed the interaction between treatment and year dummies. This approach helps assess whether there were any differential trends in the outcome variable between the treatment and control groups before the intervention. The coefficient for the interaction term is not statistically significant in the pre-intervention period (Treatment X Year 1). In other words, there were no significant differences in trends between the treatment and control groups before the intervention. This suggests that the parallel trend assumption is satisfied. Table 1.1 displays the results of the parallel trend test for this study.

Table 1. 1: Parallel Trend

	(1) Math	(2) Kiswahili
Treatment X Year 1	-0.0134	-0.2430
	(0.2064)	(0.1943)
Treatment X Year 3	0.3192	0.2885**
	(0.2243)	(0.1181)
Treatment	0.2785	0.3331**
	(0.2999)	(0.1491)
Year 1 (2014)	-0.4796***	-0.6562***
	(0.1567)	(0.1381)
Year 3 (2018)	-0.5226***	-0.2653***
	(0.1481)	(0.0800)
Controls	Yes	Yes
District and Year Fixed Effects	Yes	Yes
Observations	7348	7266
R^2	0.097	0.149

Note: Year represents year dummy and Year 1 represents the pre-intervention year dummy. Treatment X Year 1 is the interaction between treatment and pre-intervention year dummy. Year 2, which is the first year of intervention (2016) is used as a base year. Standard errors in parentheses are clustered at school level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

1.6. Results and Discussion

The findings of this study are limited to third graders because the scope of the data was limited to standard three pupil performance as well as their household and parental characteristics. Math outcomes, such as missing number questions, level 1 and level 2 addition questions, level 1 and level 2 subtraction questions, multiplication questions, and word problem questions, make up the first set of outcome variables. Kiswahili outcomes, such as reading comprehension, listening comprehension, spelling writing, punctuation writing, correct syllables read per minute, correct familiar words read per minute, correct invented words read

per minute, and correct words from passage read per minute make up the second set of outcome variables. Additionally, it is worth noting that all these outcomes are in logarithm form.

1.6.1. Impact of Professional Development Training on Students' Performance

Table 1.2 presents the difference in differences estimates of the effect of professional development (PD) training on the performance of the students. In Panel A, it is evident that teachers' professional development training improved students' performance in Kiswahili, though not significantly across all facets. For instance, columns 2 and 3 indicate that teachers' PD training significantly increased performance in listening comprehension and spelling writing. Similarly, PD training significantly enhanced students' performance over the entire examined spectrum of reading speed, as shown in columns 6 to 9. Performance in reading comprehension and punctuation writing also improved but not significantly. In addition to the improvements in Kiswahili performance, PD training was also beneficial for math performance. As demonstrated in Panel B of Table 1.2, PD training led to a significant improvement in students' performance in missing number questions and word problems. Similarly, there is a slight significant increase in performance of level 1 addition questions as well as non-significant increase in performance of level 1 subtraction and multiplication questions, as portrayed in column 2 of panel B.

These findings align with numerous studies demonstrating that professional development or in-service training for teachers enhances students' academic performance (see, for instance, Rawle et al., 2019; Didion et al., 2020; Fryer, 2017; Rockoff, 2004; Blank & Alas, 2009; Telese, 2008; Garet et al., 2001; Angrist & Lavy, 2001). One possible explanation for this improvement is the fact that EQUIP-T professional development training placed a greater emphasis on subject matter expertise and pedagogical techniques, which allowed teachers to

cultivate a more profound comprehension of the subjects they instruct and the best way to improve students' learning outcomes. This changed the way teachers instruct students owing the fact that most of the teachers, especially in developing nations like Tanzania, learned to teach using a model of instruction and learning that places a strong emphasis on memorization of facts without also placing an emphasis on a deeper grasp of subject matter. This is similar to the claim made by Porter and Brophy (1988), and Darling-Hammond and McLaughlin (1995).

The provided explanation is also supported by Desimone's (2009) claim that participating in professional development training improves teachers' instructing practices and pedagogical tactics. Furthermore, according to Gore et al. (2021), professional development training enhances the quality, motivation, and morale of teachers, which might serve as another possible explanation.

Table 1. 2: Impact of Professional Development Training on Students' Performance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Kiswahili	reading	listen	spelling	punctuate	reading speed	familiar words reading speed	invented words reading speed	passage reading speed
Treat x Post	0.0899	0.1083**	0.2096**	0.1025	0.3515***	0.2929**	0.3278***	0.2896*
	(0.0641)	(0.0495)	(0.1021)	(0.0703)	(0.1316)	(0.1397)	(0.1220)	(0.1625)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control Means	0.6602	0.9569	1.6750	1.2441	2.8084	2.3762	1.9932	2.6734
Observations	7369	7385	7386	7386	7356	7374	7345	7371
R^2	0.099	0.165	0.119	0.114	0.119	0.123	0.107	0.123
Panel B: Math	missing number	level-1 addition	level-2 addition	level-1 subtract	level-2 subtract	multiply	word problem	
Treat x Post	0.0968**	0.0981*	-0.0066	0.0159	-0.0064	0.0306	0.1517***	
	(0.0409)	(0.0551)	(0.0812)	(0.0745)	(0.0664)	(0.0598)	(0.0402)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
District and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Control Means	1.1972	1.6765	0.9983	1.3647	0.7531	0.7459	0.7805	
Observations	7386	7386	7386	7386	7386	7386	7385	
R^2	0.061	0.069	0.086	0.066	0.065	0.099	0.087	

Note: This table indicates the general impact of the treatment without considering heterogeneity. Reading speed is measured in syllables or words read per minute, but all outcomes are in logarithmic form and are thus interpreted as a percentage. Standard errors in parentheses are clustered at school level. Reading, listen, spelling and punctuate outcomes in row 1 of panel A represent reading comprehension, listening comprehension, spelling writing and punctuation writing questions respectively. Subtract and multiply in row 1 of Panel B represents subtraction and multiplication questions respectively. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

1.6.2. Impact of Professional Development Training on the Closing of Achievement Gaps for Teachers and Students

According to the results in Panel A of Table 1.3, female teachers have been more successful than male teachers in influencing students' performance in all aspects of the Kiswahili subject during the pre-treatment period (i.e., row 4). However, due to exposure to treatment, the heterogeneity changed in favor of male teachers in all facets of Kiswahili but was not completely reversed. This could imply that male teachers are narrowing the performance gap with female teachers in terms of their capacity to impact pupils' Kiswahili performance. Generally, professional development training paved the way for male teachers to close the gap in all facets of Kiswahili. Math performance also paints a similar picture. Though not statistically significant in all aspects, female teachers outperformed male teachers in influencing students' performance in all aspects of math subject in the pre-treatment period (see row 4 of panel B, Table 1.3). However, following the treatment, the heterogeneity was changed in almost all aspects in favor of male teachers, but was not completely reversed. This could likewise suggest that PD training served as an opportunity for male teachers to close performance gap with female teachers.

There are several explanations as to why female teachers outperformed male teachers. Others argue that female teachers are performing better compared to male teachers due to their teaching styles. That is, female teachers are more nurturing, expressive, and supportive than male teachers. In addition, they spend more time than male teachers applauding pupils,

permitting greater student participation, using less authoritarian language, and share their authority in the class (Islahi & Nasreen, 2013). Since teaching is not limited to lecturing, teachers must also steer students toward their whole growth by motivating, inspiring, explaining, and engaging them. In light of this, I can argue that the pedagogical techniques that were a core component of teachers' professional development training provided an opportunity for male teachers to close the performance gap with female teachers by adopting better teaching techniques and changing their teaching philosophies.

Table 1. 3: The Impact of Professional Development Training on Closing Performance Gaps Among Teachers

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Kiswahili	reading	listen	spelling	punctuate	reading speed	familiar words reading speed	invented words reading speed	passage reading speed
Treat x Female Teacher x Post	0.0890	0.1119	0.2404*	0.1720*	0.3098*	0.3807**	0.3426*	0.4038*
	(0.0930)	(0.0761)	(0.1366)	(0.0995)	(0.1816)	(0.1902)	(0.1765)	(0.2208)
Treat x Female Teacher	-0.1320	-0.1223*	-0.2863**	-0.2081**	-0.3672**	-0.4283**	-0.3682**	-0.4575**
	(0.0818)	(0.0693)	(0.1209)	(0.0903)	(0.1655)	(0.1670)	(0.1571)	(0.1935)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7331	7347	7348	7348	7318	7336	7307	7333
R^2	0.099	0.156	0.120	0.113	0.119	0.122	0.107	0.121
Panel B: Math	missing number	level-1 addition	level-2 addition	level-1 subtract	level-2 subtract	multiply	word problem	
Treat x Female Teacher x Post	0.0815	0.0744	0.1626	0.1259	0.1189	0.2180**	-0.0283	
	(0.0555)	(0.0862)	(0.1270)	(0.1046)	(0.1029)	(0.0846)	(0.0654)	
Treat x Female Teachers	-0.0839	-0.0823	-0.2027*	-0.1798*	-0.1521	-0.2224***	-0.0060	
	(0.0518)	(0.0788)	(0.1129)	(0.0932)	(0.0945)	(0.0795)	(0.0608)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
District and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Observations	7348	7348	7348	7348	7348	7348	7347	
R^2	0.059	0.065	0.085	0.062	0.065	0.097	0.086	

Note: This table depicts the change in heterogeneity of teachers' ability to impact student performance in terms of the teacher's gender. Generally, row 4 of each panel represents the situation prior to treatment with negative coefficients, whereas row 2 represents the situation after the treatment with positive coefficients. The heterogeneity was not completely removed following the treatment. All outcomes are in logarithmic form and are thus interpreted as a percentage. Standard errors in parentheses are clustered at school level. Reading, listen, spelling and punctuate outcomes in row 1 of panel A represent reading comprehension, listening comprehension, spelling writing and punctuation writing questions respectively. Subtract and

multiply in row 1 of Panel B represents subtraction and multiplication questions respectively. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In general, the professional development (PD) training was beneficial for male students, who had been outperformed by female students in all aspects of Kiswahili and math. As shown in Panel A of Table 1.4, although not statistically significant across the board, the heterogeneity favored female students in all Kiswahili facets before the treatment. However, the receipt of treatment has altered the heterogeneity in many facets in favor of male students, although it did not completely reverse it. Similarly, it changed the heterogeneity in favor of male students in many math facets after treatment, but it was only fully reversed in level 2 addition, and multiplication. This suggests that male students are narrowing the achievement gaps due to improved teacher productivity and teaching quality resulting from PD training.

Several factors explain why boys were outperformed by girls in both math and Kiswahili subjects. Others argue that girls typically show greater preparedness for learning than boys because they have more developed non-cognitive and cognitive abilities when they begin school (Himaz & Aturupane, 2021). Another potential explanation for boys' underperformance is that they receive less parental supervision than girls do (Goolamally & Ahmad, 2010). Similarly, Kulturel-Konak et al. (2011) assert that female and male pupils have different learning styles and learning preferences. In addition, Davidson (2002) contends that learning styles are related to students' learning outcomes and academic achievements. This could suggest that male students may have been underperforming due to their learning styles. For the enhancement of academic outcomes of all students, the teaching curriculum should accommodate diverse learning styles.

Table 1. 4: The Impact of Professional Development Training on Closing Performance Gaps Among Students

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Kiswahili	reading	listen	spelling	punctuate	reading speed	familiar words reading speed	invented words reading speed	passage reading speed
Treat x male student x Post	0.0684	0.0688	0.0884	0.0517	0.0016	0.0176	-0.0316	0.0787
	(0.1015)	(0.0735)	(0.1506)	(0.0982)	(0.1876)	(0.1919)	(0.1811)	(0.2224)
Treat x male student	-0.0981	-0.1293**	-0.1463	-0.0643	-0.1083	-0.1014	-0.0178	-0.1291
	(0.0869)	(0.0627)	(0.1397)	(0.0953)	(0.1790)	(0.1740)	(0.1801)	(0.1996)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7331	7347	7348	7348	7318	7336	7307	7333
R^2	0.100	0.167	0.122	0.116	0.122	0.125	0.109	0.125
Panel B: Math	missing number	level-1 addition	level-2 addition	level-1 subtract	level-2 subtract	multiply	word problem	
Treat x female student x Post	-0.0204	0.0170	0.2097*	0.1010	0.1614	0.3381***	-0.0333	
	(0.0558)	(0.0880)	(0.1227)	(0.1113)	(0.1007)	(0.0930)	(0.0783)	
Treat x female student	-0.0264	-0.0863	-0.1930*	-0.1739*	-0.2101**	-0.3231***	-0.0513	
	(0.0500)	(0.0769)	(0.0998)	(0.1052)	(0.0876)	(0.0801)	(0.0661)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
District and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Observations	7348	7348	7348	7348	7348	7348	7347	
R^2	0.063	0.070	0.087	0.068	0.067	0.104	0.090	

Note: This table depicts the change in heterogeneity of student performance by gender. Generally, row 4 of each panel represents the situation prior to treatment with negative coefficients, whereas row 2 represents the situation after the treatment with positive coefficients in most facets. The heterogeneity in Kiswahili was not totally reversed and in math was totally reversed only in level 2 addition and multiplication. All outcomes are in logarithmic form and are thus interpreted as a percentage. Standard errors in parentheses are clustered at school level. Reading, listen, spelling and punctuate outcomes in row 1 of panel A represent reading comprehension, listening comprehension, spelling writing and punctuation writing questions respectively. Subtract and multiply in row 1 of Panel B represents subtraction and multiplication questions respectively. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

1.6.3. Impact of Professional Development Training on the Closing of Performance Gaps for Students From Disadvantaged Background

A student's background, in this case, includes the number of siblings aged 0 to 17, poverty level, and the mother's literacy rate. Concerning the number of siblings, I compare treated pupils from households with four or more children aged 0-17 to treated pupils with less than four siblings aged 0-17. 'Four or more siblings' is used as a cut-off point for four reasons:

first, it represents a high fertility rate (Kollodge, 2018); second, it is close to Tanzania's fertility rate (i.e., births per woman), which is 4.8 (WB, 2022); third, it represents most treated students (i.e., 66.1% of all treated students); and fourth, it is the highest category in the data structure.

The impacts of PD training on math and Kiswahili performance vary depending on the number of siblings aged 0 – 17 that the student has. These effects are displayed in Panels A and B of Table 1.5, respectively. Treated pupils from households with four or more children aged 0 - 17 were outperformed by those from households with fewer than four children in all aspects of Kiswahili performance (see row 4 of Panel A). This is, in part, because poverty in Tanzania is strongly correlated with larger household sizes (URT, 2020). However, although not significant across all aspects, after receiving the treatment, the heterogeneity in Kiswahili performance was completely reversed in favor of students from households with four or more children aged 0 - 17. This could imply that teachers' professional development training provided them with high-quality instruction, which served as a crucial opportunity for them to close the academic achievement gaps.

The performance in math closely mirrors that observed in Kiswahili, as depicted in panel B of Table 1.5. Before the intervention, students from households with four or more children aged 0 - 17 were outperformed by their peers in all math aspects. However, this heterogeneity completely reversed after the intervention in favor of students from households with four or more children aged 0 - 17. This could also suggest that the quality of instruction and the relevant pedagogical techniques associated with the teachers' training played a crucial role in bridging the performance gaps.

Table 1. 5: The Effect of Professional Development Training on Closing Performance Gaps for Students With 4+ Siblings Aged 0 - 17

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Kiswahili	reading	listen	spelling	punctuate	reading speed	familiar words reading speed	invented words reading speed	passage reading speed
Treat **x** 4+ Siblings **x** Post	0.1874	-0.0242	0.4582***	0.3270***	0.4902**	0.5721***	0.6177***	0.6504***
	(0.1161)	(0.0746)	(0.1536)	(0.1059)	(0.2141)	(0.1999)	(0.2119)	(0.2338)
Treat **x** 4+ Siblings	-0.1438	-0.0442	-0.3652**	-0.2706**	-0.3331*	-0.4422**	-0.3957**	-0.5214**
	(0.1071)	(0.0638)	(0.1506)	(0.1055)	(0.1959)	(0.1988)	(0.1864)	(0.2287)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Districts and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7331	7347	7348	7348	7318	7336	7307	7333
R^2	0.100	0.167	0.123	0.118	0.123	0.126	0.110	0.126
Panel B: Math	missing number	level-1 addition	level-2 addition	level-1 subtract	level-2 subtract	multiply	word problem	
Treat x 4+ Siblings x Post	0.1124*	0.2140***	0.3262**	0.3607***	0.2494*	0.2886***	0.1516*	
	(0.0605)	(0.0822)	(0.1513)	(0.1231)	(0.1459)	(0.1073)	(0.0831)	
Treat x 4+ Siblings	-0.0508	-0.1730**	-0.2122*	-0.3542***	-0.1946*	-0.2349**	-0.1003	
	(0.0550)	(0.0702)	(0.1177)	(0.1244)	(0.1060)	(0.1032)	(0.0705)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Districts and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Observations	7348	7348	7348	7348	7348	7348	7347	
R^2	0.064	0.070	0.088	0.069	0.067	0.102	0.089	

Note: This table portrays the reverse heterogeneity of student performance based on whether they have 4 or more siblings aged 0-17. Row 4 of each panel represents the situation prior to treatment with negative coefficients, whereas row 2 represents the situation after the treatment with positive coefficients. All outcomes are in logarithmic form and are thus interpreted as a percentage. Standard errors in parentheses are clustered at school level. Reading, listen, spelling and punctuate outcomes in row 1 of panel A represent reading comprehension, listening comprehension, spelling writing and punctuation writing questions respectively. Subtract and multiply in row 1 of Panel B represents subtraction and multiplication questions respectively. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Students may also perform poorly academically due to poverty in their households, and PD training may pave the way for them to close achievement gaps. According to panel A of Table 1.6, though not significantly across the board, students from poor households were trailing behind in almost every aspect of Kiswahili prior to treatment. Owing to treatment receipt, students from poor households are closing the achievement gaps with those from non-poor households in all facets of Kiswahili. Notably, they are significantly bridging the performance gaps in reading speed, particularly for familiar words, invented words, and

passage reading speed. Similarly, though not significantly, panel B shows that students from poor households also appear to be closing the performance gaps in almost all aspects of the math subject.

The results align with the findings of Gross (1993), which indicate a positive correlation between pupils' cognitive abilities and their parents' socioeconomic status. This is partly because families with limited financial resources often cannot afford to make adequate educational investments for their children, such as hiring private tutors. Such investments have a significant impact on academic performance (Becker, 1964). Therefore, PD training plays a pivotal role in providing high-quality instruction and training to students from poor families, thereby enabling them to narrow the performance gaps. This is because they are designed to help teachers in developing the competencies and values required to meet the needs of all students regardless of their backgrounds (Schlager & Fusco, 2003). Owing to that, heterogeneity before the treatment was completely reversed after the treatment in favor of students from poor households.

Table 1. 6: The Impact of Professional Development Training on the Closing Performance Gaps for Students Living in Poor Households

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Kiswahili	reading	listen	spelling	punctuate	reading speed	familiar words reading speed	invented words reading speed	passage reading speed
Treat **x** Poverty **x** Post	0.1534	-0.1575**	0.1593	0.0291	0.2857	0.4095**	0.3302*	0.4760**
	(0.0980)	(0.0743)	(0.1602)	(0.1127)	(0.2013)	(0.1987)	(0.1917)	(0.2300)
Treat **x** Poverty	-0.0713	0.1377**	-0.0792	-0.0097	-0.2202	-0.3393*	-0.2443	-0.3609*
	(0.0794)	(0.0643)	(0.1425)	(0.1024)	(0.1846)	(0.1773)	(0.1700)	(0.2061)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Districts and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7331	7347	7348	7348	7318	7336	7307	7333
R^2	0.100	0.167	0.121	0.116	0.121	0.125	0.108	0.125
Panel B: Math	missing number	level-1 addition	level-2 addition	level-1 subtract	level-2 subtract	multiply	word problem	
Treat **x** Poverty **x** Post	0.0652	0.0573	0.1873	0.0625	0.0425	0.1573	-0.0345	
	(0.0629)	(0.0980)	(0.1306)	(0.1221)	(0.1233)	(0.0982)	(0.0798)	
Treat **x** Poverty	-0.0048	-0.0044	-0.0830	-0.0458	-0.0325	-0.1282	0.0509	
	(0.0549)	(0.0834)	(0.1067)	(0.1046)	(0.0997)	(0.0932)	(0.0676)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Districts and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Observations	7348	7348	7348	7348	7348	7348	7347	
R^2	0.063	0.069	0.087	0.066	0.066	0.101	0.088	

Note: This table portrays the reverse heterogeneity of student performance based on household's poverty status. Row 4 of each panel represents the situation prior to treatment with negative coefficients, whereas row 2 represents the situation after the treatment with positive coefficients. All outcomes are in logarithmic form and are thus interpreted as a percentage. Standard errors in parentheses are clustered at school level. Reading, listen, spelling and punctuate outcomes in row 1 of panel A represent reading comprehension, listening comprehension, spelling writing and punctuation writing questions respectively. Subtract and multiply in row 1 of Panel B represents subtraction and multiplication questions respectively. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

On the other hand, there is a difference in academic performance between treated students living with literate mothers (or female heads) and those living with illiterate ones, as shown in Table 1.7. Prior to the intervention, pupils living with illiterate mothers were outperformed by those living with literate ones in all aspects of the Kiswahili subject, as shown in row 4 of panel A. Nonetheless, while not significant in all aspects, the treatment has changed heterogeneity in favor of students who live with illiterate mothers in almost all facets of Kiswahili but did not completely reverse it in most facets. This could suggest that the

intervention served as a means for students living with illiterate mothers to narrow the performance gaps with those living with literate mothers.

Others argue that students who live with illiterate mothers fall behind because illiterate mothers are less successful than literate ones in instilling in their children the cognitive language abilities that are essential for early academic achievement (Benjamin, 1993). That is, literate mothers are more capable of playing their role as children's first teachers (Benjamin, 1993). Furthermore, albeit not statistically significant, changes in heterogeneity are also apparent in most aspects of math, though they have not been completely reversed. As a result, professional development training for teachers has improved the quality of instruction and pedagogical techniques, which have proven more beneficial for students living with illiterate mothers.

Therefore, family background plays a great role in students' performance. According to Coleman's (1966) theory, families are more important in shaping the academic success of students compared to schools and communities. That is, parental educational involvement, such as participating in school activities, discussing school issues with their children, reviewing their children's homework, can enhance pupils' academic achievement (Pong et al., 2005). However, the involvement of parents in their children's education is constrained by several factors, including household poverty, mothers' literacy, and having many children aged 0 to 17. For instance, having many children aged 0 - 17 could result in a disproportionately small distribution of family resources (including time) among children, potentially resulting in lower educational investments. This is consistent with Becker's (1964) contention that disadvantaged families often struggle to make sufficient educational investments for their children, such as hiring private tutors, which has an impact on their children's academic achievements.

Table 1. 7: The Impact of Professional Development Training on the Closing Performance Gaps for Students Living With Illiterate Mothers

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Kiswahili	reading	listen	spelling	punctuate	reading speed	familiar words reading speed	invented words reading speed	passage reading speed
Treat x Mother's illiteracy x Post	0.1536	-0.0309	0.2779	0.1404	0.3010	0.4424**	0.3577*	0.5366**
	(0.1110)	(0.0806)	(0.1697)	(0.1171)	(0.2198)	(0.2184)	(0.2065)	(0.2473)
Treat x Mother's illiteracy	-0.1711*	-0.0517	-0.3194**	-0.1807*	-0.3437*	-0.4793***	-0.3876**	-0.5028**
	(0.0919)	(0.0685)	(0.1459)	(0.1039)	(0.1885)	(0.1834)	(0.1762)	(0.2104)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7331	7347	7348	7348	7318	7336	7307	7333
R^2	0.102	0.169	0.125	0.121	0.123	0.128	0.109	0.127
Panel B: Math	missing number	level-1 addition	level-2 addition	level-1 subtract	level-2 subtract	multiply	word problem	
Treat x Mother's illiteracy x Post	0.0029	0.0852	0.0988	0.1265	0.0309	0.1665	-0.0012	
	(0.0663)	(0.0984)	(0.1345)	(0.1301)	(0.1233)	(0.1096)	(0.0783)	
Treat x Mother's illiteracy	0.0033	-0.1283	-0.1562	-0.1551	-0.1422	-0.1678*	-0.0591	
	(0.0520)	(0.0899)	(0.1066)	(0.1195)	(0.1006)	(0.0904)	(0.0656)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Region and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Observations	7348	7348	7348	7348	7348	7348	7347	
R^2	0.063	0.070	0.087	0.067	0.067	0.101	0.089	

Note: This table depicts the change in heterogeneity of student performance in terms of mother's literacy. Generally, row 4 of each panel represents the situation prior to treatment with negative coefficients, whereas row 2 represents the situation after the treatment with positive coefficients in almost all facets. All outcomes are in logarithmic form and are thus interpreted as a percentage. Standard errors in parentheses are clustered at school level. Reading, listen, spelling and punctuate outcomes in row 1 of panel A represent reading comprehension, listening comprehension, spelling writing and punctuation writing questions respectively. Subtract and multiply in row 1 of Panel B represents subtraction and multiplication questions respectively. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

1.7. Robustness Check

1.7.1. Alternative Outcome Variable

I employed person Rasch scores in mathematics and Kiswahili as an alternative measure of the outcomes used in this study for a robustness check. In essence, I used mathematics and Kiswahili performance, based on person Rasch scores, to examine the effect of professional development (PD) training on closing achievement gaps. The advantage of

using this performance measure is that it simultaneously considers a person's ability and item difficulties. The results based on Rasch scores generally align with the results derived from disaggregated mathematics and Kiswahili outcomes. These results are presented in Table A 1.3 to A 1.8 in the appendix.

1.7.2. Alternative Identification Strategy

As this study's results are derived from count data, a negative binomial model was employed as a robustness check. The findings obtained from the negative binomial model largely align with the results from the primary methodology (refer to Tables A 1.9 to A 1.14 in the appendix).

1.8. Conclusion

Professional Development (PD) training improves both teachers and pupils performance. However, it is crucial to acknowledge the presence of heterogeneity in both pre-treatment and post-treatment performance. If the heterogeneity in the pre-treatment period favors one group and the heterogeneity in the post-treatment period favors another group, it may imply that one group is closing the achievement gap. The difference-in-difference estimator, which accounts for pre- and post-treatment heterogeneity, was employed to examine the effect of PD training on the closing of achievement gaps. The findings reveal that, during the pre-treatment period, female teachers outperformed male teachers in influencing students' performance. However, following the treatment, the heterogeneity shifted in favor of male teachers. This suggests that PD training provided male teachers with an opportunity to narrow the performance gap with their female counterparts. This also holds true for male students, who have generally been outperformed by their female counterparts in Kiswahili and math subjects

but have narrowed the achievement gaps due to high-quality instruction and relevant pedagogical techniques associated with PD training.

On the other hand, family background, plays a crucial role in students' performance. There is evidence of differences in performance in both math and Kiswahili based on the number of children aged 0-17 in the households, poverty, and mothers' literacy. Generally, the PD program opened the door for students from households with four or more children aged 0-17 to close the performance gaps with those from households with fewer than four children aged 0 – 17. Similarly, PD training allowed pupils from poor households to close the performance gaps with those from non-poor households. Moreover, it enabled the pupils living with illiterate mothers to close the achievement gaps with those living with literate ones.

The shift in the performance gap between male and female teachers suggests that PD programs should be gender inclusive. This means PD training should be tailored to address specific needs or preferences that different genders may have. Encouraging and enabling more male teachers to participate in professional development can be seen as a positive policy step to address gender disparities in influencing students' learning outcomes. On the other hand, Teacher PD trainings should be designed to address the specific needs of students, taking into account gender differences in learning styles and preferences. Training modules could incorporate techniques that have proven effective in narrowing gender-based achievement gaps.

The influence of family background on student performance underscores the importance of addressing socio-economic disparities in education. Policy efforts should focus on providing additional support and resources to students from larger households, economically disadvantaged backgrounds, and households with illiterate mothers. To promote equity in student outcomes, education policymakers should ensure that students from diverse

backgrounds have access to PD-trained teachers. This may entail offering incentives for teacher participation in PD training within disadvantaged communities or allocating resources for PD training to schools with a higher proportion of disadvantaged students.

The findings of this study suggest that professional development (PD) training is an effective method for assisting teachers and students in closing the achievement gaps. That is, PD training in Tanzania is more of a mechanism for closing the achievement gaps. Therefore, to bridge achievement gaps and improve overall education quality, allocating resources to PD training should be a priority. Even though it is not a one-size-fits-all approach, PD training can contribute to ensuring that neither teachers nor students are left behind. Succinctly, policymakers should recognize the value of investing in high-quality teacher PD training. In essence, regular assessment of the impact of PD programs is crucial. That is, policymakers should establish mechanisms for ongoing evaluation to ensure that these programs are effectively addressing performance gaps and promoting equity. Adjustments to PD program content and delivery methods may be needed based on the evolving needs and characteristics of teachers and students.

This study is not without limitations. High teacher turnover hampered the effectiveness of the EQUIP-T program's interventions (Ruddle & Rawle, 2020). One explanation for this is that high turnover interrupts the consistency and continuity of instruction, potentially impeding students' learning progress. High teacher turnover also affects the intensity of training since new teachers may be exposed to less program content. For instance, Yoon et al. (2007) found that improvements in teaching practices and student achievement are positively associated with the intensity and duration of PD training. Consequently, high teacher turnover may have lessened the effect of PD training on students' academic achievement.

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Appendix

Table A 1.1: Summary Statistics

Characteristic	Obs	Mean	Std. dev.
Panel A: Pupils characteristics and their household characteristics			
Female	10101	0.538	0.499
Pupil age	8906	10.346	1.43
Household Size	9944	7.453	2.798
Households with 4+ members aged 0 – 17	9944	0.661	0.473
Mother's Literacy	8889	0.635	0.481
Poverty status of the household	9943	0.397	0.489
Household ownership of radio	9946	0.489	0.5
Household ownership of lanterns	9946	0.256	0.436
Household ownership of charcoal/ electric irons	9946	0.248	0.432
Household ownership of tables	9946	0.636	0.481
Household ownership of vehicles	9946	0.577	0.494
Household having earth wall	9946	0.754	0.431
Household with mud/grass/leaves/bamboo roof	9946	0.387	0.487
Panel B: Teachers and school characteristics			
Treated	10102	0.503	0.5
Female Teachers	10102	0.443	0.497
Teacher's getting reward	9733	0.545	0.498
Teacher's Satisfaction	9440	7.718	1.668
Headteacher's Satisfaction	9440	8.333	1.645
School having Staffroom	10102	0.947	0.224
School having electricity	10102	0.226	0.418
School having water source	10102	0.473	0.499
Number of classrooms	10102	7.533	2.4
Number of toilets	10102	9.339	5.084
School having library	10102	0.146	0.353
School has working computers	10102	0.058	0.234
School has a development plan	10102	0.492	0.5
Panel C: Outcome Variables used for estimation			
Math Performance			
Log of Missing number scores	10099	1.202	0.474
Log of Level-1 addition scores	10099	1.684	0.715
Log of Level-2 addition scores	10099	0.999	0.855
Log of Level-1 subtraction scores	10099	1.371	0.862
Log of Level-2 subtraction scores	10099	0.755	0.808
Log of Multiplication scores	10099	0.746	0.698
Log of Word problem scores	10098	0.771	0.507
Kiswahili Performance			
Log of Reading comprehension scores	10080	0.673	0.618
Log of Listening comprehension scores	10099	0.977	0.559
Log of Spelling writing scores	10100	1.731	1.042
Log of Punctuation writing scores	10100	1.282	0.726
Log of syllables reading speed	10060	2.853	1.354
Log of familiar words reading speed	10088	2.426	1.338
Log of invented words reading speed	10054	2.026	1.297
Log of Passage's words reading speed	10082	2.735	1.512

Table A 1.2: Balance Test

Variables	Treatment	Control	Mean Diff
Number of Pupils who passed primary school leaving exam	26.15	25.253	0.897
School having Staffroom	0.871	0.923	-0.053***
School having electricity	0.097	0.111	-0.015
School having water source	0.495	0.412	0.083***
Number of classrooms	6.983	7.284	-0.302***
Number of toilets	8.324	10.094	-1.771***
School having library	0.164	0.171	-0.007
School has working computers	0.014	0.043	-0.029***
School has a development plan	0.420	0.514	-0.095***
Teacher's education	0.980	0.967	0.014
Teacher's getting reward	0.377	0.556	-0.178***
Teacher's Satisfaction	7.599	7.532	0.068
Headteacher's Satisfaction	8.135	8.357	-0.221***
Teachers' absence in school	0.115	0.100	0.015
Teachers Presence in classrooms	0.346	0.345	0.000
Female Teachers	0.444	0.429	0.015
Female pupils	0.543	0.500	0.044**
Pupil age	10.256	10.145	0.111**
Household Size	7.732	7.296	0.436***
Households with 4+ members aged 0 - 17	0.625	0.633	-0.008
Female head of household	0.822	0.711	0.111***
Mothers who are literate	0.634	0.701	-0.067***
Poverty status of the household	0.316	0.383	-0.066***
Household ownership of radio	0.553	0.596	-0.044**
Household ownership of lanterns	0.302	0.355	-0.053***
Household ownership of charcoal/ electric irons	0.338	0.353	-0.015
Household ownership of tables	0.721	0.671	0.050***
Household ownership of vehicles	0.688	0.552	0.136***
Household having earth wall	0.757	0.744	0.013
Household with mud/grass/leaves/bamboo roof	0.355	0.470	-0.115***

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A 1.3: Impact of Professional Development Training on Students' Performance

	(1) Math	(2) Kiswahili
Treat X Post	0.1903	0.4035**
	(0.1671)	(0.1732)
Controls	Yes	Yes
District and year fixed effects	Yes	Yes
Observations	7348	7266
R^2	0.096	0.147

Note: This table indicates the general impact of the treatment without considering heterogeneity. Standard errors in parentheses are clustered at school level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A 1.4: The Impact of Professional Development Training on the Closing of Performance Gaps for Teachers Based on Gender

	(1) Math	(2) Kiswahili
Treat X Male Teacher X Post	0.3256	0.5076**
	(0.2386)	(0.2371)
Treat x Male Teacher	-0.4427*	-0.5569**
	(0.2271)	(0.2217)
Controls	Yes	Yes
District and year fixed effects	Yes	Yes
Observations	7348	7266
R^2	0.097	0.149

Note: This table depicts the catch up in terms of teachers' ability to impact student performance based on the teacher's gender. Generally, row 3 represents the situation prior to treatment with negative coefficients, whereas row 1 represents the situation after the treatment with positive coefficients. Standard errors in parentheses are clustered at school level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A 1.5: The Impact of Professional Development Training on the Closing of Performance Gaps for Students Based on Gender

	(1) Math	(2) Kiswahili
Treat x Male student x Post	0.2854	-0.0472
	(0.2253)	(0.2349)
Treat x Male student	-0.4432**	-0.0036
	(0.2076)	(0.2344)
Controls	Yes	Yes
District and year fixed effects	Yes	Yes
Observations	7348	7266
R^2	0.098	0.149

Note: This table depicts the catching up of students who are trailing behind in math and Kiswahili performance by gender. Generally, row 3 represents the situation prior to treatment, whereas row 1 represents the situation after the treatment. Standard errors in parentheses are clustered at school level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A 1.6: The Impact of Professional Development Training on the Closing of Performance Gaps for Students With 4+ Siblings Aged 0 - 17

	(1) Math	(2) Kiswahili
Treat x 4+ Siblings x Post	0.8250***	0.5710**
	(0.2999)	(0.2655)
Treat x 4+ Siblings	-0.6044**	-0.4347*
	(0.2389)	(0.2454)
Controls	Yes	Yes
District and year fixed effects	Yes	Yes
Observations	7348	7266
R^2	0.098	0.149

Note: This table portrays the reverse heterogeneity of student performance based on whether they have 4 or more siblings aged 0-17. Row 3 represents the situation prior to treatment with negative coefficients, whereas row 1 represents the situation after the treatment with positive coefficients. Standard errors in parentheses are clustered at school level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A 1.7: The Impact of Professional Development Training on the Closing of Performance Gaps for Students Living in Poor Households

	(1) Math	(2) Kiswahili
Treat x poverty x Post	0.2156	0.3631
	(0.2677)	(0.2504)
Treat x poverty	-0.1305	-0.2847
	(0.2352)	(0.2335)
Controls	Yes	Yes
District and year fixed effects	Yes	Yes
Observations	7348	7266
R^2	0.096	0.148

Note: This table depicts the catch up of students who are trailing behind in math and Kiswahili performance based on the household poverty status. Generally, row 3 represents the situation prior to treatment, whereas row 1 represents the situation after the treatment. Standard errors in parentheses are clustered at school level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A 1.8: The Impact of Professional Development Training on the Closing of Achievement Gaps for Students Living With Illiterate Mothers

	(1) Math	(2) Kiswahili
Treat x Mother's illiteracy x Post	0.2618	0.5046*
	(0.2926)	(0.2718)
Treat x Mother's illiteracy	-0.4702*	-0.5014**
	(0.2519)	(0.2462)
Controls	Yes	Yes
School and year fixed effects	Yes	Yes
N	7348	7266
R^2	0.098	0.152

Note: This table depicts the change in heterogeneity of student performance in terms of mother's literacy. Generally, row 3 represents the situation prior to treatment with negative coefficients, whereas row 1 represents the situation after the treatment with positive coefficients. Standard errors in parentheses are clustered at school level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A 1.9: Impact of Professional Development Training on Students' Performance (Negative Binomial Regression)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Kiswahili	reading	listen	spelling	punctuate	reading speed	familiar words reading speed	invented words reading speed	passage reading speed
Treat x Post	0.1588	0.1373**	0.1640**	0.0913	0.1994***	0.1653*	0.1758*	0.1499*
	(0.1198)	(0.0631)	(0.0777)	(0.0705)	(0.0754)	(0.0883)	(0.0902)	(0.0894)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7369	7385	7386	7386	7356	7374	7345	7371
pseudo R^2	0.027	0.045	0.011	0.024	0.006	0.007	0.006	0.006
Panel B: Math	missing number	level-1 addition	level-2 addition	level-1 subtract	level-2 subtract	multiply	word problem	
Treat x Post	0.1088**	0.0629	-0.0191	0.0201	-0.0055	0.0363	0.2266***	
	(0.0492)	(0.0413)	(0.0969)	(0.0613)	(0.1100)	(0.0942)	(0.0687)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
District and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Observations	7386	7386	7386	7386	7386	7386	7385	
pseudo R^2	0.015	0.013	0.014	0.009	0.012	0.024	0.024	

Note: This table indicates the general impact of the treatment without considering heterogeneity. Reading speed is measured in syllables or words read per minute. Standard errors in parentheses are clustered at school level. Reading, listen, spelling and punctuate outcomes in row 1 of panel A represent reading comprehension, listening comprehension, spelling writing and punctuation writing questions respectively. Subtract and multiply in row 1 of Panel B represents subtraction and multiplication questions respectively. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A 1.10: The Impact of Professional Development Training on the Closing of Performance Gaps for Teachers Based on Gender (Negative Binomial Regression)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Kiswahili	reading	listen	spelling	punctuate	reading speed	familiar words reading speed	invented words reading speed	passage reading speed
Treat x male Teacher x Post	0.2347	0.1194	0.1743*	0.1757*	0.1428	0.2059*	0.2659**	0.2291*
	(0.1642)	(0.0974)	(0.1004)	(0.0998)	(0.1059)	(0.1192)	(0.1294)	(0.1250)
Treat x male Teacher	-0.2954**	-0.1415	-0.2152**	-0.2023**	-0.1950**	-0.2773***	-0.3261***	-0.2875***
	(0.1471)	(0.0914)	(0.0917)	(0.0927)	(0.0984)	(0.1055)	(0.1161)	(0.1111)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7331	7347	7348	7348	7318	7336	7307	7333
pseudo R^2	0.028	0.042	0.011	0.024	0.006	0.007	0.007	0.006
Panel B: Math	missing number	level-1 addition	level-2 addition	level-1 subtract	level-2 subtract	multiply	word problem	
Treat x male Teacher x Post	0.0992	0.0624	0.1816	0.1097	0.1753	0.2897**	-0.0332	
	(0.0679)	(0.0618)	(0.1494)	(0.0897)	(0.1726)	(0.1301)	(0.1078)	
Treat x male Teachers	-0.1105*	-0.0690	-0.2475*	-0.1702**	-0.2216	-0.2941**	-0.0142	
	(0.0658)	(0.0576)	(0.1327)	(0.0826)	(0.1585)	(0.1220)	(0.1029)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
District and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Observations	7348	7348	7348	7348	7348	7348	7347	
pseudo R^2	0.014	0.012	0.013	0.008	0.012	0.023	0.023	

Note: This table depicts the change in heterogeneity of teachers' ability to impact student performance in terms of the teacher's gender. Generally, row 4 of each panel represents the situation prior to treatment with negative coefficients, whereas row 2 represents the situation after the treatment with positive coefficients. The heterogeneity was not completely removed following the treatment. Standard errors in parentheses are clustered at school level. Reading, listen, spelling and punctuate outcomes in row 1 of panel A represent reading comprehension, listening comprehension, spelling writing and punctuation writing questions respectively. Subtract and multiply in row 1 of Panel B represents subtraction and multiplication questions respectively. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A 1.11: The Impact of Professional Development Training on the Closing of Performance Gaps for Students Based on Gender (Negative Binomial Regression)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Kiswahili	reading	listen	spelling	punctuate	reading speed	familiar words reading speed	invented words reading speed	passage reading speed
Treat x male student x Post	0.1664	0.0179	0.0874	0.0646	-0.0091	-0.0239	-0.0290	0.0347
	(0.1869)	(0.0940)	(0.1153)	(0.0959)	(0.1045)	(0.1184)	(0.1360)	(0.1228)
Treat x male student	-0.2217	-0.1180	-0.1359	-0.0689	-0.0448	-0.0237	0.0273	-0.0687
	(0.1620)	(0.0798)	(0.1041)	(0.0918)	(0.1020)	(0.1087)	(0.1339)	(0.1113)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7331	7347	7348	7348	7318	7336	7307	7333
pseudo R^2	0.028	0.046	0.011	0.025	0.007	0.007	0.007	0.006
Panel B: Math	missing number	level-1 addition	level-2 addition	level-1 subtract	level-2 subtract	Multiply	word problem	
Treat x male student x Post	-0.0209	0.0195	0.2623*	0.0952	0.2083	0.5318***	-0.0880	
	(0.0675)	(0.0675)	(0.1443)	(0.0938)	(0.1625)	(0.1449)	(0.1306)	
Treat x male student	-0.0382	-0.0552	-0.2460**	-0.1399	-0.2685*	-0.4879***	-0.0552	
	(0.0612)	(0.0604)	(0.1226)	(0.0912)	(0.1456)	(0.1202)	(0.1120)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
District and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Observations	7348	7348	7348	7348	7348	7348	7347	
pseudo R^2	0.015	0.013	0.014	0.009	0.012	0.025	0.025	

Note: This table depicts the change in heterogeneity of student performance by gender. Generally, row 4 of each panel represents the situation prior to treatment with negative coefficients, whereas row 2 represents the situation after the treatment with positive coefficients in most facets. The heterogeneity in Kiswahili was not totally reversed and in math was totally reversed only in level 2 addition and multiplication. Standard errors in parentheses are clustered at school level. Reading, listen, spelling and punctuate outcomes in row 1 of panel A represent reading comprehension, listening comprehension, spelling writing and punctuation writing questions respectively. Subtract and multiply in row 1 of Panel B represents subtraction and multiplication questions respectively. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A 1.12: The Impact of Professional Development Training on the Closing of Performance Gaps for Students With 4+ Siblings Aged 0 - 17 (Negative Binomial Regression)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Kiswahili	reading	listen	spelling	punctuate	reading speed	familiar words reading speed	invented words reading speed	passage reading speed
Treat **x** 4+ Siblings **x** Post	0.3039	-0.0013	0.3185***	0.2936***	0.2413**	0.3928***	0.4717***	0.3757***
	(0.1943)	(0.0931)	(0.1170)	(0.1056)	(0.1214)	(0.1365)	(0.1529)	(0.1432)
Treat **x** 4+ Siblings	-0.2717	-0.0628	-0.2625**	-0.2508**	-0.1527	-0.2966**	-0.3293**	-0.2899**
	(0.1818)	(0.0832)	(0.1160)	(0.1082)	(0.1122)	(0.1328)	(0.1369)	(0.1411)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Districts and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7331	7347	7348	7348	7318	7336	7307	7333
pseudo R^2	0.028	0.046	0.011	0.025	0.007	0.007	0.007	0.006
Panel B: Math	missing number	level-1 addition	level-2 addition	level-1 subtract	level-2 subtract	multiply	word problem	
Treat x 4+ Siblings x Post	0.1028	0.1556**	0.3763**	0.2736***	0.3204	0.3661**	0.2434*	
	(0.0726)	(0.0628)	(0.1770)	(0.1043)	(0.2359)	(0.1680)	(0.1396)	
Treat x 4+ Siblings	-0.0422	-0.1447***	-0.2508*	-0.2737***	-0.2687	-0.2427	-0.1743	
	(0.0642)	(0.0553)	(0.1418)	(0.1024)	(0.1756)	(0.1511)	(0.1167)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Districts and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Observations	7348	7348	7348	7348	7348	7348	7347	
pseudo R^2	0.015	0.013	0.014	0.009	0.012	0.025	0.024	

Note: This table portrays the reverse heterogeneity of student performance based on whether they have 4 or more siblings aged 0-17. Row 4 of each panel represents the situation prior to treatment with negative coefficients, whereas row 2 represents the situation after the treatment with positive coefficients. Standard errors in parentheses are clustered at school level. Reading, listen, spelling and punctuate outcomes in row 1 of panel A represent reading comprehension, listening comprehension, spelling writing and punctuation writing questions respectively. Subtract and multiply in row 1 of Panel B represents subtraction and multiplication questions respectively. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A 1.13: The Impact of Professional Development Training on the Closing of Performance Gaps for Students Living in Poor Households (Negative Binomial Regression)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Kiswahili	reading	listen	spelling	punctuate	reading speed	familiar words reading speed	invented words reading speed	passage reading speed
Treat **x** Poverty **x** Post	0.3436*	-0.1617*	0.1591	0.0411	0.1625	0.3203**	0.2555*	0.3152**
	(0.1976)	(0.0982)	(0.1298)	(0.1240)	(0.1211)	(0.1366)	(0.1472)	(0.1385)
Treat **x** Poverty	-0.2387	0.1367	-0.0967	-0.0165	-0.1727	-0.3009**	-0.2311*	-0.2789**
	(0.1655)	(0.0879)	(0.1195)	(0.1159)	(0.1125)	(0.1237)	(0.1329)	(0.1249)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Districts and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7331	7347	7348	7348	7318	7336	7307	7333
pseudo R^2	0.028	0.045	0.011	0.024	0.006	0.007	0.006	0.006
Panel B: Math	missing number	level-1 addition	level-2 addition	level-1 subtract	level-2 subtract	multiply	word problem	
Treat **x** Poverty **x** Post	0.1081	0.0299	0.2374	0.0713	0.0311	0.3144**	-0.0684	
	(0.0791)	(0.0714)	(0.1677)	(0.1028)	(0.2101)	(0.1544)	(0.1427)	
Treat **x** Poverty	-0.0498	-0.0133	-0.1402	-0.0424	-0.0035	-0.2553*	0.0787	
	(0.0701)	(0.0634)	(0.1404)	(0.0941)	(0.1744)	(0.1447)	(0.1238)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Districts and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Observations	7348	7348	7348	7348	7348	7348	7347	
pseudo R^2	0.015	0.013	0.014	0.009	0.012	0.024	0.024	

Note: This table portrays the reverse heterogeneity of student performance based on household's poverty status. Row 4 of each panel represents the situation prior to treatment with negative coefficients, whereas row 2 represents the situation after the treatment with positive coefficients. Standard errors in parentheses are clustered at school level. Reading, listen, spelling and punctuate outcomes in row 1 of panel A represent reading comprehension, listening comprehension, spelling writing and punctuation writing questions respectively. Subtract and multiply in row 1 of Panel B represents subtraction and multiplication questions respectively. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A 1.14: The Impact of Professional Development Training on the Closing of Achievement Gaps for Students Living With Illiterate Mothers (Negative Binomial Regression)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Kiswahili	reading	listen	spelling	punctuate	reading speed	familiar words reading speed	invented words reading speed	passage reading speed
Treat x Mother's illiteracy x Post	0.4324**	-0.0237	0.2632*	0.1873	0.1640	0.3067**	0.2552	0.3289**
	(0.2186)	(0.1120)	(0.1390)	(0.1310)	(0.1323)	(0.1525)	(0.1597)	(0.1554)
Treat x Mother's illiteracy	-0.4293**	-0.1004	-0.3100**	-0.2338*	-0.2165*	-0.3435***	-0.3376**	-0.3364**
	(0.1904)	(0.0974)	(0.1215)	(0.1209)	(0.1138)	(0.1302)	(0.1372)	(0.1350)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7331	7347	7348	7348	7318	7336	7307	7333
pseudo R^2	0.029	0.047	0.012	0.026	0.007	0.008	0.007	0.006
Panel B: Math	missing number	level-1 addition	level-2 addition	level-1 subtract	level-2 subtract	multiply	word problem	
Treat x Mother's illiteracy x Post	0.0638	0.0887	0.1508	0.1117	0.0520	0.2896	0.0102	
	(0.0880)	(0.0749)	(0.1711)	(0.1158)	(0.2090)	(0.1815)	(0.1386)	
Treat x Mother's illiteracy	-0.0684	-0.1266*	-0.2324*	-0.1545	-0.2164	-0.2797*	-0.1053	
	(0.0696)	(0.0694)	(0.1403)	(0.1081)	(0.1764)	(0.1471)	(0.1190)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Region and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Observations	7348	7348	7348	7348	7348	7348	7347	
pseudo R^2	0.015	0.013	0.014	0.009	0.012	0.024	0.024	

Note: This table depicts the change in heterogeneity of student performance in terms of mother's literacy. Generally, row 4 of each panel represents the situation prior to treatment with negative coefficients, whereas row 2 represents the situation after the treatment with positive coefficients in almost all facets. Standard errors in parentheses are clustered at school level. Reading, listen, spelling and punctuate outcomes in row 1 of panel A represent reading comprehension, listening comprehension, spelling writing and punctuation writing questions respectively. Subtract and multiply in row 1 of Panel B represents subtraction and multiplication questions respectively. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

CHAPTER TWO

Professional Competence and Working Behaviors: The Role of Leader's and Subordinate's Job Satisfaction

Abstract

The satisfaction of both leaders and subordinates plays a vital role in influencing the competence and work behaviors of subordinates. However, the significance of a leader's satisfaction in shaping a subordinate's competence and work behaviors has often been overlooked. This study utilizes data from the Education Quality Improvement Program in Tanzania (EQUIP-T) for the years 2014, 2016, and 2018. The findings reveal that both the satisfaction of leaders and subordinates exhibits a positive association with the professional competence of subordinates. Similarly, both types of satisfaction are associated with subordinate's favorable work behaviors, including decreased absenteeism and enhanced collaborative efforts. These findings underscore that leader and subordinate satisfaction are not substitutable but rather complement each other in shaping competence and work-related behaviors within an organization.

Keywords: *Competence, Working behaviors, Leaders, Subordinates, Job satisfaction*

2.1. Introduction

Increasing worker satisfaction is an effective way of increasing their productivity, competence, and performance (Böckerman & Ilmakunnas, 2012). One major factor contributing to low job performance, competence and productivity is low satisfaction (Zelenski, et al., 2008; Yankelovich, 1979). Low job satisfaction is associated with an increased incidence of anxiety, depression, and poor mental health (Ho & Au, 2006; French et al., 1982). Anxiety and depression in subordinates and leaders can hinder their performance and competence. The leaders and subordinates who are satisfied tend to give more effort, behave well at the workplace and work harder than those who are less satisfied (Ho & Au, 2006; Gross & Etzioni, 1985). According to Harrison (1995), an increase in the unit level satisfaction raises the expected utility of showing up at work and, as a result, acts as a buffer to reduce unexcused absences. Recent studies also paint the same picture; for instance, Hausknecht et al. (2008) and Davey et al. (2009) found that increased job satisfaction is linked with lower absenteeism. Noteworthy, this study refers to a headteacher as a leader and to a teacher as subordinate/employee.

The significance of teachers' job satisfaction should not be underestimated. It plays a critical role in alleviating the psychological and teaching stress experienced by teachers (Ho & Au, 2006). Additionally, teacher satisfaction has a positive correlation with various aspects of their professional life. It is associated with enhanced teacher performance (Chamundeswari, 2013), increased work engagement (Høigaard et al., 2012; Timms & Brough, 2013; Klassen et al., 2012), and greater self-efficacy (Gkolia & Koustelios, 2014; Høigaard et al., 2012). Similarly, teachers' job satisfaction has a beneficial effect on classroom dynamics. It reduces instances of classroom misbehavior among teachers and enhances their ability to manage their

classrooms (Ho & Au, 2006). Moreover, it is worth noting that teachers' job satisfaction has far-reaching implications for teacher retention. Noordin and Jusoff (2009) emphasize its significance in this regard.

In contrast to existing studies, my study mainly focuses on investigating the association between leader satisfaction and subordinate competence, as well as the association between leader satisfaction and subordinate work behaviors. In essence, most of the existing literature focuses on how leaders' behaviors or leadership styles affect subordinate performance (Kilroy et al., 2023; Erskine & Georgiou, 2017; Ferris & Rowland, 1981; Ogola, et al., 2017; Okoji, 2016), and not on how leaders' satisfaction shapes subordinates' competence and work behaviors. Similarly, studies exploring the subject of job satisfaction mostly examine the correlation between employee satisfaction and their job performance as well as productivity (e.g., Chamundeswari, 2013; Böckerman & Ilmakunnas, 2012; Khan, et al., 2012). However, according to Gardner (1986) and Han et al. (2019), one of the leader manager's tasks is motivating the subordinates; but how can a leader with low job satisfaction effectively achieve this? A leader experiencing low job satisfaction is also likely to have low motivation and morale, making it challenging for them to motivate their subordinates. Also, though most studies focus on leaders' behaviors, leaders' satisfaction in large part affects the way leader behaves as it is for the satisfaction of employees.

Despite not receiving adequate attention, the importance of headteacher/leader satisfaction in shaping the professional competence and work behaviors of teachers/subordinates within an organization cannot be underestimated. While it is widely acknowledged that a teacher's satisfaction is crucial for their professional competence and work behaviors (Chamundeswari, 2013; Høigaard, et al., 2012; Ho & Au, 2006), the satisfaction of

a school's headteacher is equally vital for enhancing teachers' competence and work behaviors. This perspective stems from the distinct roles of teachers and headteachers, with teachers primarily focused on instructing and inspiring learning, while headteachers bear the responsibility of professionally managing and leading the school (Rouse, 2008; Penlington et al., 2008; Hammersley-Fletcher & Brundrett, 2005; Reeves, et al., 2003). Unsatisfied leaders may struggle to provide effective leadership, make appropriate decisions, and set a clear direction for the organization. Owing to that, if only subordinates find satisfaction in their roles, it can lead to confusion, a lack of focus, and a feeling of being adrift among subordinates.

On the other hand, an increase in job satisfaction is associated with good and favorable work-related behaviors (Mount & Johnson, 2006; Gross & Etzioni, 1985). The positive behaviors demonstrated by leaders have a beneficial impact on employees' engagement in citizenship behaviors and their commitment to their jobs (Kilroy et al., 2023). This is because leadership and the behavior of leaders not only serve to alleviate work-related stress but also contribute significantly to boosting employee morale, motivation, and job satisfaction (Erskine & Georgiou, 2017). In general, a leader has a considerable impact on both the mental health and work competence of their subordinates (Montano et al., 2017). Leader behavior affects the job perception of subordinates, which in turn impacts subordinates' behavior and attitudes toward the job (Ferris & Rowland, 1981; Kilroy et al., 2023; Townsend et al., 2022).

My study also investigates the satisfaction of leaders as an important factor contributing to the enhancement of subordinates' feedback-giving behavior. This stands in contrast to most existing feedback studies which focus on the influence of factors such as the relationship between the giver and receiver of feedback (Ramani et al., 2020; Huffman et al., 2021; Adams,

2005), trust (Carless, 2012), and a psychologically secure atmosphere (Ajjawi et al., 2022; Johnson et al., 2020) on the act of giving feedback.

In contrast to most studies, my study explains the processes by which a leader's job satisfaction is related to subordinates' competence and working behaviors. In the context of this study, I posit that there are four distinct processes explaining why a leader's satisfaction (i.e., headteacher) is significant for a subordinate's (i.e., teacher) competence and work behaviors. Firstly, leader satisfaction trickles down to subordinates. The trickle-down concept examined in this study differs from existing research that focused on different subjects, such as the trickle-down impact of supervisors' perspectives (Ambrose et al., 2013) and the trickle-down effect of a leader's psychological disengagement from work (Sonnentag & Schiffner, 2019). The "trickle-down" effect occurs when the perceptions, attitudes, and behaviors of a leader cause comparable perceptions, attitudes, and behaviors in subordinates (Ambrose et al., 2013; Sonnentag & Schiffner, 2019). Additionally, existing studies do not focus on the relationship between headteacher satisfaction and teachers' satisfaction but rather on the relationship between leadership exhibited by headteachers and the job satisfaction experienced by teachers (Nguni et al., 2006; Eliophotou-Menon & Ioannou, 2016; Leithwood & Sun, 2012).

Secondly, leaders' satisfaction plays a vital role in influencing the extent to which leaders value their subordinates' profession. This aspect has received little attention in previous research. Existing studies have primarily concentrated on examining the extent to which leaders value the profession and contributions of their subordinates in relation to employee discretionary behaviors (Eisenberger et al., 2002; Kilroy et al., 2023). However, these studies have not explored factors like leaders' job satisfaction, which can significantly impact how leaders value their subordinates' professions and contributions within the organization. Thirdly,

when leaders are satisfied, they are more likely to evaluate the work/tasks of their subordinates. This ensures tasks meet the required standard and align with the organization's goals and aspirations. This is supported by Locke (1984) claim that control measures, including performance evaluations and supervisor pressure, can help to increase employee's performance even at times when their satisfaction is low. Fourthly, satisfied leaders are more likely to assess the work plans of subordinates. This assessment helps leaders identify weaknesses that may impede subordinates' competence and provides support to ensure the successful fulfillment of subordinates' responsibilities.

To enrich this study, I also investigate the association between a subordinate's satisfaction and their competence, as well as the association between subordinate satisfaction and subordinate work behaviors. Since leaders and subordinates play different roles within the organization, their satisfactions are not interchangeable. Therefore, it is crucial to also investigate the role of subordinate satisfaction in shaping their competence and work behaviors. For instance, when only leaders are satisfied in their roles, it might lead to reduced involvement, commitment, and cooperation from subordinates. Consequently, leaders may find it challenging to ensure the smooth operation of the organization.

This study utilizes data from the Education Quality Improvement Program in Tanzania (EQUIP-T) for the years 2014, 2016, and 2018. The advantage of these surveys is that they have separate data on teachers' and headteachers' satisfaction. Teacher satisfaction assesses how content teachers are with their teaching roles, while headteachers' satisfaction gauges their contentment with their leadership and management responsibilities within the school. The surveys also have data on working behaviors and competence of subordinates. Employing the

Least Squares Dummy Variable (LSDV) regression model, I assessed the role of leaders' and subordinates' satisfaction in shaping competence and working behaviors of subordinates.

The findings of this paper show that leader satisfaction has a positive relationship with subordinates' professional competence. Additionally, leader satisfaction is associated with subordinates' positive work behaviors, such as workplace presence. Furthermore, the leader's satisfaction improves the subordinate's feedback-giving behavior. On the other hand, subordinate satisfaction is positively associated with their competence and positive work behaviors, such as showing up for work, working, and giving feedback. These findings underscore that leader and subordinate satisfaction are not substitutable but rather complement each other in shaping competence and work-related behaviors within an organization. As a result, the findings of this study contribute to the literature in a variety of ways. First, it adds to the expanding body of literature on the role of the leader in subordinate competency and working behaviors. Second, it contributes to literature on the role of job satisfaction in performance. Third, it adds to the body of knowledge on the subordinates' feedback-giving behavior.

The remainder of the paper is organized as follows: First, it discusses the study's data and the conceptual framework. Second, it describes the identification strategy and highlights the study's findings. Finally, it presents the conclusion.

2.2. Data and contexts

The study uses data from the Education Quality Improvement Program in Tanzania (EQUIP-T) surveys. The survey provides a rich set of data on time varying covariates related to teachers, and schools as well as regional, district, and school fixed effects. Teachers were chosen using systematic random sampling for the baseline survey, but for the midline and

endline surveys, all teachers were included in the sample to increase the sample size. However, the data does not have a panel for teachers.

The initial survey took place in 2014, with subsequent follow-up surveys conducted in 2016 (midline) and 2018 (endline), respectively. The study examines the association between job satisfaction and working behaviors using all three surveys. However, it uses only baseline and midline surveys for assessing the relationship between satisfaction and competence as they are the only surveys with data on teachers' professional competence. In this context, subject knowledge is used to assess a teacher's professional competence. Teachers were asked to answer questions about whole numbers, fractions, geometry, algebra, decimals, percentages, and measurements aspects of math to assess their subject knowledge and thus their development needs. Their scores were recorded, and they represent the teachers' knowledge and competence in the above-mentioned aspects of math. Competence in this context is the ability to perform a task based on knowledge, skills, and attitudes that are relevant and supportive to that task (Billett et al., 2014).

The advantage of this survey is that it has separate data on teachers' and headteachers' satisfaction. Teacher satisfaction assesses how content teachers are with their teaching roles, while headteachers' satisfaction gauges their contentment with their leadership and management responsibilities within the school. The survey also has data on various aspects of working behavior, such as teacher absenteeism from school and classroom, teachers' feedback to headteachers on students' performance, headteachers observations of teaching as well as headteachers assessment of teacher's lesson plan. Table A 2.1 in the appendix, shows the descriptive statistics for the variables considered in this study.

2.3. Conceptual Framework

This study is grounded in reciprocity theory. The theory postulates that, when one party acts in a way that benefits the other party or provides a service that benefits the other party, the benefactee may reciprocate and pay back the other party for the benefit obtained by engaging in certain positive actions/behaviors or less negative actions/behaviors (Gouldner, 1960). According to Gouldner (1960, p.170) “the generalized norm of reciprocity evokes obligations toward others on the basis of their past behavior”. Succinctly, the theory is centered on the reciprocal benefit-exchange between two or more parties.

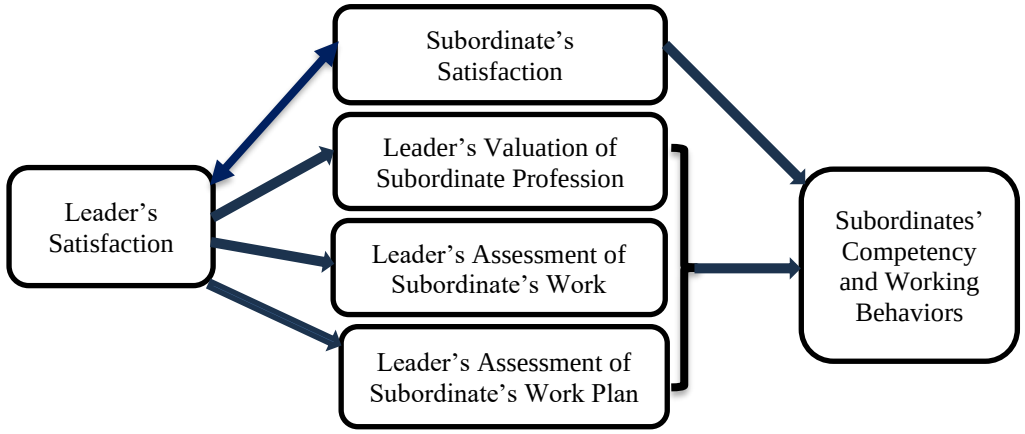
Figure 2.1 depicts the conceptual model and processes by which a leader's job satisfaction is associated with subordinates' competence and working behaviors. Firstly, I contend that a leader's job satisfaction is positively associated with subordinate’s job satisfaction. An increase in job satisfaction is related to good and favorable work-related behaviors (Mount & Johnson, 2006; Gross & Etzioni, 1985). Additionally, leaders exhibiting positive behaviors can reduce stress among their subordinates (Erskine & Georgiou, 2017) and enhance their mental well-being (Montano et al., 2017). Owing to that, satisfaction of the leader can trickle down to their subordinates. Notably, there is a two-sided relationship between leader satisfaction and subordinate satisfaction.

Secondly, I posit that leader satisfaction is positively associated with the extent to which leaders value the professions of their subordinates, as well as their inclination to assess the work and work plans of their subordinates. These actions taken by leaders convey to their subordinates a sense of caring and interest in both their work and their professional growth. Consequently, this triggers the norm of reciprocity, encouraging subordinates to respond in kind by engaging in positive actions and behaviors that mirror their leaders' actions and

behaviors. That is, subordinates respond to their leaders' actions and behaviors by improving their competences and displaying positive work-related behaviors. Additionally, the leader's actions mentioned above establish a zone of reciprocity, such as perceptions of support received from leaders and the organization, which encourages employees to engage in discretionary behaviors (Kilroy et al., 2023). The concept of a zone of reciprocity underscores that it is not just a single factor but rather the interplay of multiple influences that shape reciprocity in the workplace (Kilroy et al., 2023).

Drawing upon reciprocity theory (Gouldner, 1960) and zone of reciprocity (Kilroy et al., 2023), I argue that the relationships examined in this study hold relevance in any organizational context characterized by a leader-subordinate dynamic.

Figure 2. 1: Conceptual Framework



Note: This conceptual framework shows four distinct processes that explain why a leader's satisfaction is associated with the competence and work behaviors of subordinates. The first channel demonstrates that leader satisfaction trickles down to subordinates (vice versa is also true). The second to fourth channels form the zone of reciprocity, which encourages the reciprocation of a leader's positive actions/behaviors by subordinates.

2.4. Identification Strategy

The study employed the Least Squares Dummy Variable (LSDV) model to investigate the relationship between a leader's job satisfaction and subordinate professional competence, as well as the relationship between a leader's satisfaction and the work behaviors of subordinates.

Equation (2.1) represents the relationship between leader satisfaction and subordinate competence.

$$Subordinate\_Competence_{it} = \beta Leader\_Satisfy_{it} + \gamma X_{it} + \alpha_s + \rho_t + \varepsilon_{it} \quad (2.1)$$

Equation (2.2) represents the association between leader satisfaction and subordinate work behaviors.

$$Subordinate\_Behavior_{it} = \beta Leader\_Satisfy_{it} + \gamma X_{it} + \alpha_s + \rho_t + \varepsilon_{it} \quad (2.2)$$

Where $Subordinate\_Competence_{it}$ represents the competence of teacher i at time t. $Subordinate\_Behavior_{it}$ represents the teachers' working behaviors which are teacher's absence from school, presence in the classroom, absence from the classroom on days when teachers are scheduled to teach, and teachers' feedback-giving behaviors (i.e., feedback giving to headteachers on students' progress). $Leader\_Satisfy_{it}$ stands for the headteacher's job satisfaction at time t. X_{it} represents school characteristics (i.e., staffroom, electricity, water, classrooms, and library), teacher characteristics (i.e., age, age square, gender, professional education, teaching experience, and in-service training), reward, community support, ward education coordinator (WEC) support, general teaching support, and school development plan as shown in Panel A of Table A 2.1 in the appendix. α_s represents the school fixed effects while

ρ_t represents the year fixed effect. $\boldsymbol{\varepsilon_i}$ is the error term. Moreover, the standard errors are clustered at the school level.

In addition, I used the Least Squares Dummy Variable (LSDV) model to examine the mechanisms that explain why leader satisfaction is associated with the competence and work behaviors of subordinates.

Equation (2.3) illustrates the trickle-down model, which represents the first mechanism.

$$Subordinate\_Satisfy_{it} = \beta Leader\_Satisfy_{it} + \gamma X_{it} + \alpha_s + \rho_t + \varepsilon_{it} \quad (2.3)$$

Where $Subordinate\_Satisfy_{it}$ represents the satisfaction of teacher i at time t.

Equation (2.4) illustrates the relationship between headteacher satisfaction and the degree to which headteachers value the profession of teachers (i.e., teaching role). This represents the second mechanism.

$$Leader\_Value_{it} = \beta Leader\_Satisfy_{it} + \gamma X_{it} + \alpha_s + \rho_t + \varepsilon_{it} \quad (2.4)$$

$Leader\_Value_{it}$ represents the extent to which headteacher values the teaching role. X_{it} represents school and headteacher's characteristics.

Equation (2.5) illustrates the relationship between headteacher satisfaction and their evaluation of teachers work/tasks (i.e., classroom observations). This represents the third mechanism.

$$Leaderwork\_Evaluate_{it} = \beta Leader\_Satisfy_{it} + \gamma X_{it} + \alpha_s + \rho_t + \varepsilon_{it} \quad (2.5)$$

$Leaderwork\_Evaluate_{it}$ represents headteacher classroom observation, which is one of the main ways of evaluating teaching performance.

Equation (2.6) shows the association between headteacher satisfaction and headteacher assessment of subordinate work plan (i.e., lesson plan). This represents the fourth mechanism.

$$Leaderplan\_Assess_{it} = \beta Leader\_Satisfy_{it} + \gamma X_{it} + \alpha_s + \rho_t + \varepsilon_{it} \quad (2.6)$$

$Leaderplan\_Assess_{it}$ represents headteacher assessment of lesson plan of teachers and X_{it} represents school and headteacher's characteristics.

To enrich my study, I also employed the Least Squares Dummy Variable (LSDV) model to examine the relationship between subordinate's job satisfaction and their professional competence, as well as the association between a subordinate's satisfaction and the work behaviors of subordinates.

Equation (2.7) represents the association between subordinate satisfaction and subordinate's competence:

$$Subordinate\_Competence_{it} = \beta Subordinate\_Satisfy_{it} + \gamma X_{it} + \alpha_s + \rho_t + \varepsilon_{it} \quad (2.7)$$

Equation (2.8) represents the association between subordinate satisfaction and subordinate's work behaviors:

$$Subordinate\_Behavior_{it} = \beta Subordinate\_Satisfy_{it} + \gamma X_{it} + \alpha_s + \rho_t + \varepsilon_{it} \quad (2.8)$$

Where $Subordinate\_Satisfy_{it}$ represents teachers' satisfaction with their teaching role.

2.5. Results and Discussion

2.5.1. The Role of Leader's Satisfaction for Subordinate Competence and Working Behaviors

Leader's Satisfaction and Subordinate Competence

As shown in Table 2.1, leader satisfaction is positively associated with subordinate's competence. Headteacher satisfaction has a significant positive association with teachers' competence in whole numbers, geometry, algebra, decimals, and measurements facets of math. Similarly, though not significantly, headteacher satisfaction is positively associated with teacher competence in fraction and percentage. This is consistent with the findings of Easthope and Easthope (2000) that an increase in job satisfaction has a positive impact on the quality of the job being performed. This means that headteacher satisfaction improves the quality of the duties they perform, such as managing, leading, and ensuring the school's successful operation.

The positive association between leader satisfaction and subordinate competence could be explained by the fact that satisfied leaders behave well at work. That is, an increase in job satisfaction is related to good working behaviors (Mount & Johnson, 2006). In a nutshell, when leaders are satisfied and interested in their jobs, they are more likely to demonstrate positive behaviors including assessing subordinates' work/work plans, providing clear instructions, and providing constructive feedback. This, in turn, can inspire subordinates to reciprocate their leaders' positive behaviors by enhancing their performance, leading to increased competency. Similarly, a leader's behavior affects subordinate's extrinsic motivation, which can in turn boost his or her intrinsic motivation (Lepper & Henderlong, 2000). Additionally, an increase in the level of satisfaction of a leader increases their stability, discipline, and responsibility (see,

Hajdukova et al., 2015) which are good for leader's effectiveness and thereby subordinate's competence.

A satisfied leader, on the other hand, can foster a good work atmosphere that reduces stress and anxiety in subordinates (Grayson & Alvarez, 2008; Borg & Riding, 1991). Subordinates who are less stressed out can focus better on their work and perform more competently. Like employees, leaders who are more satisfied with their jobs put in more effort and work harder than those who are less satisfied (Ho & Au, 2006; Gross & Etzioni, 1985). Furthermore, job satisfaction boosts job commitment (Shann, 1998) as well as job efficacy and extra-role working behaviors (Klassen et al., 2009; Somech & Drach-Zahavy, 2000). This suggests that satisfied leaders exhibit higher levels of dedication, effectiveness, and reliability in contributing to the development of their organizations.

Table 2. 1: The Association Between Leader's Satisfaction and Subordinate's Competence

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Whole number	Geometry	Algebra	Fraction	Decimal	Percent	Measure
Headteacher Satisfaction	0.1514*	0.2235**	0.2944***	0.0976	0.1325*	0.0550	0.1328***
	(0.0816)	(0.1107)	(0.0949)	(0.0659)	(0.0783)	(0.0454)	(0.0458)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	893	893	893	893	893	893	893
R^2	0.576	0.592	0.643	0.540	0.553	0.575	0.535

Note: Percent and measure represent percentage and measurements questions respectively. The controls used are school characteristics (i.e., staffroom, electricity, water, classrooms, and library), teacher characteristics (i.e., age, age square, gender, professional education, teaching experience, and in-service training), reward, community support, ward education coordinator (WEC) support, general teaching support, and school development plan. Standard errors in parentheses are clustered at school level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Leader's Satisfaction and Subordinate Working Behaviors

The leader's satisfaction is also important for the working behaviors of their subordinates. Table 2.2 reveals a significant negative association between headteacher satisfaction and both teachers' school absences and classroom absences on scheduled teaching days. This aligns with the findings of Kuoppala et al. (2008), who found that leaders are crucial in lowering absenteeism. Headteacher satisfaction is also positively correlated with teachers' presence in the classroom on all days, regardless of whether they are scheduled to teach or not. The headteacher satisfaction is important for ensuring good working behaviors because it improves leaders' behaviors. Improvement in leaders' behaviors lowers subordinates work stress and increases their job satisfaction (Erskine and Georgiou 2017). Subordinates thus reciprocate their leaders' good behavior by engaging in positive behaviors such as showing up to work and working.

On the other hand, Column 4 of Table 2.2 reveals a positive association between headteacher satisfaction and the behavior of teachers providing feedback to the headteacher. One plausible explanation is that higher levels of satisfaction tend to reduce stress (Ho and Au, 2006; French et al., 1982) and enhance the stability and discipline of the leader (Hajdukova et al., 2015). This, in turn, makes more satisfied leaders generally more approachable than their less satisfied counterparts. In other words, subordinates are more likely to feel comfortable sharing their thoughts, suggestions, and work-related challenges with satisfied and content leaders. In addition, the increase in satisfaction is associated with an increase in commitment and professionalism (Syptak et al., 1999). Thus, leader satisfaction may cause leaders to display a high level of professionalism. This motivates subordinates to express their opinions and concerns, knowing that they will be handled professionally. Likewise, heightened leader

commitment stemming from job satisfaction may lead them to actively seek the input of their subordinates, thereby fostering opportunities for feedback.

Table 2. 2: The Association Between Leader's Satisfaction and Subordinate's Working Behaviors

	(1)	(2)	(3)	(4)
	School absence	Classroom presence (All days)	Classroom absence (Teaching days)	Feedback to headteacher
Headteacher Satisfaction	-0.0075*	0.0277**	-0.0466***	0.0534***
	(0.0039)	(0.0134)	(0.0143)	(0.0196)
Controls	Yes	Yes	Yes	Yes
School and Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	2652	2158	1707	847
R^2	0.207	0.267	0.302	0.581

Note: The controls used are school characteristics (i.e., staffroom, electricity, water, classrooms, and library), teacher characteristics (i.e., age, age square, gender, professional education, teaching experience, and in-service training), reward, community support, ward education coordinator (WEC) support, general teaching support, and school development plan. Standard errors in parentheses are clustered at school level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Why Leader's Satisfaction is Related to Subordinates Competence and Working Behaviors?

There are various pathways that link a leader's satisfaction to competence as well as the work behaviors of subordinates. That is, there are four independent mechanisms that contribute to the explanation of why a leader's satisfaction is related to subordinates' competence and working behaviors.

First, headteacher satisfaction is associated with the extent to which headteachers value the role and profession of their subordinates. One of the leader's responsibilities is to provide work-related support to subordinates and to assist them in developing their potential (Erskine & Georgiou, 2017). Furthermore, one cannot fully commit to supporting and improving the performance of someone or something they do not highly value. Succinctly, for a leader, such as a headteacher, to help teachers enhance their teaching competence, valuing their role as

teachers is essential. In other words, the level of support that a headteacher provides to teachers may depend on the value they assign to the teaching profession. According to column 1 in Table 2.3, headteacher's satisfaction is positively associated with the extent to which headteachers value the teaching role. The extent to which leaders value the profession and contributions of their subordinates is associated with subordinates' perceptions of how the organization values them, as they perceive their leader as the representative of the organization (Eisenberger et al., 2002). This perceived support from the organization is associated with positive employee discretionary behaviors (Kilroy et al., 2023).

Therefore, if leaders provide signals that they greatly value their subordinates' professions and their subordinates pick up on the signal, a strong norm of cooperation and collaboration might be established between leaders and their subordinates. Based on the reciprocity theory, I can argue that, when subordinates perceive that their leader cares about and values their profession, they are more likely to reciprocate by putting more effort into their work and engaging in collaborative activities that are vital for the fulfillment of organizational goals. This explains why headteacher satisfaction is important for teacher's competence and work-related behaviors.

Second, the satisfaction of the leader contributes to the subordinate's satisfaction. Column 2 of Table 2.3 shows the trickle-down model of a leader's satisfaction with their job. That is, leader satisfaction is positively correlated to subordinate satisfaction. This is because satisfied leaders can foster a good work atmosphere that reduces stress and anxiety in subordinates (Grayson & Alvarez, 2008). Similarly, an increase in job satisfaction is associated with good and favorable work-related behaviors (Ho & Au, 2006; Gross and Etzioni, 1985). Thus, a satisfied leader who demonstrates positive behaviors and fosters a supportive work

environment can enhance the job satisfaction of their subordinates. This is consistent with Erskine and Georgiou's (2017) claim that a leader's positive behavior is important not just for lowering subordinate work stress but also for improving their morale, motivation, and job satisfaction. This increase in subordinate job satisfaction benefits the improvement of their competence and working behaviors. Noteworthy, subordinate satisfaction also influences leader's satisfaction (see Table A 2.2, appendix).

Third, leaders should evaluate and monitor the quality of their subordinates' tasks to improve task performance in the organization. This ensures tasks meet the required standard and align with the organization's goals and aspirations. This evaluation is vital for improving individual worker competence and, ultimately, organizational performance. This is supported by Locke (1984) claim that control measures, including goal setting and performance evaluations that consider both the quantity and quality of an employee's work, and supervisor pressure, can help to increase employee's performance even at times when their level of satisfaction is low. Column 3 of Table 2.3 demonstrates a significant and positive association between headteacher satisfaction and headteacher observation of classroom instructions. This implies that, for headteachers/leaders to effectively observe and monitor the quality of their subordinates'/teachers' tasks and ensure that they are not subpar, their satisfaction should be considered.

Fourth, a leader's satisfaction is positively related to a leader's evaluation of the work plan of their subordinates. The assessment of the work plan is critical to ensuring that planned tasks are pragmatic and align with the organization objectives and aspirations. The assessment also assists leaders in identifying weaknesses that may impede subordinates' performance and competence. It allows leaders to make necessary adjustments and provide assistance for the

successful fulfillment of subordinates' responsibilities. Moreover, this helps leaders in determining the areas that should be prioritized when it comes to professional development training. Based on the findings on column 4, Table 2.3, headteacher satisfaction is positively related to the headteacher assessment of the teacher's lesson plan. Therefore, satisfied leaders are more likely to exhibit collaborative efforts at work. This is consistent with the Likert (1961) assertation that high job satisfaction improves collaborative efforts at the workplace. This is also one of the possible explanations as to why headteacher satisfaction improves teacher competence and work behaviors.

Table 2. 3: Mechanisms That Facilitate the Association Between Leader's Satisfaction and Subordinate Competences

	(1) Teaching value	(2) Teacher satisfaction	(3) Teaching observation	(4) Lesson plan assessment
Headteacher satisfaction	0.0661*	0.6961***	0.0265**	0.0111*
	(0.0363)	(0.0554)	(0.0118)	(0.0059)
Controls	Yes	Yes	Yes	Yes
School and Year Fixed effects	Yes	Yes	Yes	Yes
Observations	2658	2661	2670	2672
R^2	0.364	0.762	0.395	0.260

Note: Teaching value represents assessment of how headteacher values teacher role. The controls used are school characteristics (i.e., staffroom, electricity, water, classrooms, and library), headteacher characteristics (i.e., age, age square, gender, professional education, experience, and in-service training); community support, ward education coordinator (WEC) support, general teaching support, and school development plan. Standard errors in parentheses are clustered at school level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

2.5.2. Subordinate's Satisfaction, Competence and Working Behaviors

Subordinate's Satisfaction and Competence

Subordinates' satisfaction is positively related to their competence in the tasks they perform. As indicated in Table 2.4, teacher satisfaction is significantly and positively

associated with teacher competence in the whole number, decimal, and measurement aspects of mathematics. In addition, though not significantly, teacher's satisfaction is positively related to teacher's competence in geometry, algebra, fraction, and percentage. This is consistent with the findings of Easthope and Easthope (2000) that a decrease in job satisfaction has a negative impact on the quality of a teacher's job performance.

The improvement in teacher's competence due to increased level of satisfaction stems from the fact that increased job satisfaction leads to increased job efficacy and extra-role working behaviors (Klassen et al., 2009; Somech & Drach-Zahavy, 2000). Likewise, an increase in teacher's satisfaction reduces stress (Grayson & Alvarez, 2008; Borg & Riding, 1991) and increases teachers' job commitment (Shann, 1998); all of which are important for teacher's competence. Employees who are more satisfied with their jobs, on the other hand, put in more effort and work harder than those who are less satisfied (Gross & Etzioni, 1985).

Table 2. 4: The Association Between Subordinate's Satisfaction and Competence

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Whole number	Geometry	Algebra	Fraction	Decimal	Percent	Measure
Teacher satisfaction	0.1489*	0.1691	0.1856	0.0918	0.1530*	0.0612	0.1029*
	(0.0816)	(0.1406)	(0.1300)	(0.0803)	(0.0899)	(0.0606)	(0.0599)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	893	893	893	893	893	893	893
R^2	0.248	0.275	0.273	0.256	0.233	0.295	0.223

Note: Percent and measure represent percentage and measurements questions respectively. The controls used are school characteristics (i.e., staffroom, electricity, water, classrooms, and library), teacher characteristics (i.e., age, age square, gender, professional education, teaching experience, and in-service training), reward, community support, ward education coordinator (WEC) support, general teaching support, and school development plan. Standard errors in parentheses are clustered at school level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Subordinate's Job Satisfaction and Working Behaviors

Subordinates' satisfaction with their job also boosts beneficial workplace behaviors. According to Panel A of Table 2.5, teacher satisfaction is significantly and negatively related to teacher absence from school. This is consistent with Harrison's (1995) findings that high level of job satisfaction may reduce absenteeism since the expected utility of attendance is high. It is also consistent with recent studies (Hausknecht et al., 2008; Davey et al., 2009) showing that increased job satisfaction is linked with lower absenteeism.

Though not significantly, teacher satisfaction is also positively related to teacher presence in the classroom and negatively related to teacher absence in the classroom on days when they are scheduled to teach. This is consistent with the findings of Gross and Etzioni (1985) and Ho and Au (2006), who discovered that when employees are satisfied, they tend to behave well at work. Reduction in classroom and school absenteeism may be because an increase in job satisfaction increases the discipline and responsibility of subordinates, in this case teachers (Hajdukova et al., 2015). In general, an employee's behavior at work may indicate how satisfied they are with their job.

Panel B, on the other hand, reveals that teacher's satisfaction is positively related to teacher reporting of pupils' performance progress to headteacher. That is, when subordinates are satisfied with their jobs, they are more likely to provide feedback on their jobs and other issues that may hamper organization effectiveness and productivity. This is consistent with Locke's (1984) contention that workers with low levels of satisfaction may refuse to share crucial information with their superiors or leaders. This refusal can ultimately lead to a reduction in organizational effectiveness and productivity. This is because feedback is of great importance in assisting leaders or headteachers in adjusting and enhancing the organization's

or school's performance. The increase in the likelihood of subordinates providing performance feedback to their leader stems from the fact that satisfied employees tend to be more committed and demonstrate a high level of professionalism (Syptak et al., 1999).

Teachers' performance feedback to headteachers reflects the collaborative effort made by satisfied subordinates to improve organizational performance. According to Likert (1961), subordinates with low job satisfaction cannot contribute effectively to collaborative efforts toward organizational goals, which are school goals in this case. Therefore, high teachers' job satisfaction leads to high collaborative efforts towards organizational goals (Likert, 1961) and greater teacher commitment (Smith & Cranny, 1968). This, in turn, enhances the effectiveness and efficiency of the headteacher in leading and managing the school. Succinctly, a satisfied workforce provides a leader with a reliable workforce (Bateman & Organ, 1983).

Table 2. 5: The Association between Subordinate's Satisfaction and Working Behaviors

	(1)	(2)	(3)
Panel A: School/Classroom absenteeism	School Absence	Classroom presence (all days)	Classroom Absence (teaching days)
Teacher Satisfaction	-0.0080**	0.0103	-0.0278
	(0.0038)	(0.0149)	(0.0182)
Controls	Yes	Yes	Yes
School and Year Fixed Effects	Yes	Yes	Yes
Observations	2652	2158	1707
R^2	0.208	0.263	0.294
Panel B: Teacher's collaborative efforts	Feedback to headteacher		
Teacher Satisfaction	0.0427***		
	(0.0157)		
Controls	Yes		
School and Year Fixed Effects	Yes		
Observations	847		
R^2	0.581		

Note: The controls used are school characteristics (i.e., staffroom, electricity, water, classrooms, and library), teacher characteristics (i.e., age, age square, gender, professional education, teaching experience, and in-service training), reward, community support, ward education coordinator (WEC) support, general teaching support, and school development plan. Standard errors in parentheses are clustered at school level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

2.6. Conclusion

Workers represent the most crucial resource within an organization because, without them, the organization would struggle to achieve its goals and fulfill its mission (Fulmer & Ployhart, 2014; Ilagan & Javier, 2014). Therefore, it is essential to ensure that workers are satisfied with their jobs to encourage positive behavior in the workplace and enhance their competence. Employing the Least Squares Dummy Variable (LSDV) regression model, I find that both leaders' and subordinates' satisfaction are positively associated with the professional competence of subordinates. Similarly, both types of satisfaction relate to working behaviors that are important for effectiveness of the organization, such as subordinates' presence in the workplace. In addition, leader satisfaction, along with subordinate satisfaction, enhances the subordinate's feedback-giving behavior (i.e., performance feedback to leaders).

Leader and subordinate satisfaction are not substitutes for one another, but rather complements. This implies that to improve subordinate competence and ensure good working behaviors, both leaders and their subordinates must be satisfied with their jobs. The effectiveness of the leader is determined by the attitude and behavior of their subordinates, which is in turn determined by their level of satisfaction. When subordinates are highly satisfied, they tend to be more collaborative and cooperative toward organizational goals, putting up more effort and working harder. Owing to that, a satisfied subordinate offers a leader with a dependable and effective workforce. Succinctly, if subordinates are less satisfied, leaders might be less effective in improving organizational performance and productivity.

On the other hand, any organization wishing to improve the competency of its subordinates/employees should ensure that leaders are satisfied with their jobs. This is crucial because leader satisfaction indirectly improves subordinate satisfaction, fosters a more

competent workforce, and increases the value that leaders place on the professions of their subordinates. When leaders are satisfied, they are more likely to exhibit positive behaviors such as assessing the quality of the subordinates' tasks and work plans, as well as providing clear guidance and constructive feedback. This, in turn, can inspire subordinates to improve their performance, leading to increased competency. Similarly, constructive feedback, clear guidance, and support from satisfied leaders improve employees' comprehension of their tasks and responsibilities. Therefore, a satisfied leader is more likely to foster an environment in which subordinates are engaged and committed to their task.

In essence, satisfaction and positive working behaviors are contagious. For instance, leader satisfaction can influence subordinate satisfaction, and conversely, the satisfaction of subordinates can also affect the leader's satisfaction. This creates a mutually influential dynamic within the organization. When only leaders are satisfied in their roles, it leads to reduced involvement, commitment, and cooperation from subordinates. Consequently, leaders may find it challenging to ensure the organization's smooth operation. Put simply, leaders might encounter difficulties in effectively motivating, managing, and retaining their subordinates.

On the other hand, if only subordinates find satisfaction in their roles, it can lead to confusion, a lack of focus, and a feeling of being adrift among subordinates. This is because unsatisfied leaders may struggle to provide effective leadership, make appropriate decisions, and set a clear direction for the organization. Unsatisfied leaders may also find it challenging to motivate and engage their subordinates. This can lead to decreased subordinate morale, productivity, and commitment to the organization's goals. Therefore, the findings of this study

suggest that for the organization to operate efficiently, it is crucial for both leaders and subordinates to be satisfied with their jobs.

This study has several limitations. First, as proposed by Locke (1976), individual factors contribute to performance, ability, effort, or even personality, but because the data lacks a teacher panel, the teacher/individual fixed effect cannot be applied. Second, due to omitted variable bias and reverse causality, the study does not allow for causal interpretation, particularly on the relationship between competence and satisfaction. That is, on the one hand, a worker's satisfaction may motivate them to work harder and put more effort into their task, which will help them become more competent. On the other hand, if workers feel more competent, they will feel more in control of their work and will therefore be less stressed by it, which will raise their level of job satisfaction. Owing to that, if a relevant instrument variable or experimental data exists, these findings can be replicated to provide a causal interpretation.

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Appendix

Table A 2.1: Descriptive Statistics for the Variables Used for Analysis

Variable	Observations	Mean	Std. Dev.
Panel A: School and Teachers characteristics			
School having Staffroom	6628	.937	.243
School having electricity	6628	.143	.35
School having water source	6628	.442	.497
Number of classrooms	6628	7.274	2.039
School having a library	6628	.171	.377
School has a development plan	6567	.484	.5
Female Teachers	6628	.445	.497
Teacher's age	2060	38.203	12.902
Teacher's age squared	2060	1625.839	1065.266
Teacher having a professional education	2060	.979	.143
Teaching Experience	2060	7.417	7.734
Teacher received in-service training	2060	.353	.478
Female headteacher	10086	.175	.38
Headteacher age	10071	41.871	8.695
Headteacher age squared	10071	1828.734	759.331
Headteacher having a professional education	10086	1	0
Headteacher Experience	10071	3.853	4.353
Headteacher received in-service training	9733	.647	.478
Teacher's getting reward	6255	.501	.5
Support provided to improve teaching	2030	.944	.229
Support from Ward Education Coordinators	6029	.974	.158
Community valuation of teaching role	2048	6.658	2.579
Panel B: Variables of Interest in the study			
Teacher's Satisfaction	5996	7.66	1.67
Headteacher's Satisfaction	5996	8.341	1.64
Panel C: Outcome Variables used for estimation			
Teaching Competence (Math)			
Whole number scores	2256	4.904	1.395
Geometry scores	2256	2.606	1.869
Algebra scores	2256	2.36	1.698
Fraction scores	2256	2.894	1.261
Decimal scores	2256	2.832	1.182
Percentage scores	2256	1.763	.766
Measurement scores	2256	.993	.84
Working Behaviors			
Teacher's absence in school	5246	.109	.311
Teacher's presence in classroom	4474	.357	.479
Teacher's absence in classroom on teaching days	3774	.637	.481
Teacher reporting student performance to headteacher	1072	.768	.427
Teaching observation by headteacher	2055	.495	.5
Headteacher assessment of lesson plan	3096	.932	.251
Headteacher valuation of teaching role	2045	8.716	1.496

Table A 2.2: The Association Subordinate's Satisfaction and Leader's Satisfaction

	(1)
	Headteacher Satisfaction
Teacher Satisfaction	0.7096***
	(0.0695)
Controls	Yes
School and Year Fixed Effects	Yes
Observations	2674
R^2	0.752

Note: The controls used are school characteristics (i.e., staffroom, electricity, water, classrooms, and library), teacher characteristics (i.e., age, age square, gender, professional education, teaching experience, and in-service training), reward, community support, ward education coordinator (WEC) support, general teaching support, and school development plan. Standard errors in parentheses are clustered at school level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

CHAPTER THREE

Unpacking Time Use Patterns and Heterogeneity: A Multifaceted Analysis of Work, Household, and Leisure Activities

Abstract

This paper unpacks the patterns and heterogeneity in the allocation of time to market work, household production, as well as leisure and relaxation activities, with a specific focus on the life cycle of both children and individuals. This study not only updates but also enhances and reinforces the findings of existing studies by considering dimensions such as employment status, race, and education, which have received limited attention in previous time-use studies focused on child's and individual life cycle. Through descriptive analysis of American Time Use Survey (ATUS) data spanning from 2003 to 2021, I unveil that time use pattern and heterogeneity evolve throughout the child's life cycle and individual's stages of life. For instance, bachelor's degree (BA) holders allocate more time to work-related activities than non-BA holders, with the gap increasing as the child grows from infancy to age 17. However, they allocate less time on socializing and leisure compared to non-BA holders. The findings of this study provide valuable insights for policymakers, employers, and individuals striving for a more balanced and productive life.

Keywords: *Time allocation, Pattern, Heterogeneity, Life cycle*

3.1. Introduction

Time is a limited vital resource for human beings and the way people spend it could be attributed to their objective and subjective wellbeing (Knabe et al., 2010; Kahneman et al., 2006). This is because time is an essential input in everything one wishes to do or become (Goodin et al., 2008). Utility maximizing individual optimally divide their time between activities that generate income and those that do not (Becker, 1965). Allocating the time for paid work helps people achieve their basic needs and reduce their income poverty (Colella & Van Soest, 2013; Bardasi & Wodon, 2006). Similarly, time use for household activities such as domestic and care work are significant for household stability and household consumption. This is because household is a miniature factory that combines capital, raw materials, and labor to clean, feed, reproduce, and manufacture useful commodities (Becker, 1965). However, given that work as well as domestic activities, particularly caregiving responsibilities, can be physically and emotionally taxing and thus result in exhaustion and burnout, an individual needs to allocate some time for relaxing and leisure for their recovery and improvement in subjective well-being (Sonnentag et al., 2022; Oerlemans et al., 2014; Demerouti et al., 2009).

This paper focuses on comprehensive analysis of time utilization patterns and disparities. It offers a multifaceted examination of time allocation encompassing work and work-related tasks, household production activities, and socializing, relaxation, and leisure activities, within various demographic and socio-economic contexts. Specifically, it analyzes variations in time use within distinct demographic segments, including the contrast between employed and unemployed individuals, the comparison between males and females, as well as disparities based on racial and educational backgrounds. This paper reaffirms and strengthens prior research findings by conducting an updated analysis of gender disparities in time

allocation, specifically in the domains of work and work-related activities, as well as household production and leisure activities.

Unlike most existing studies, this study primarily focuses on the comprehensive analysis of time use patterns and heterogeneity across the life cycle of children in households. In essence, prevailing literature predominantly centers on the comparison between individuals with children and those without (Apps & Rees, 2005) or the examination of motherhood and parenthood (Syrda, 2023; Grinza et al., 2017; Craig & Mullan, 2010; Blossfeld & Drobnic, 2001; Lundberg, 2005; Bianchi, 2000; Budig & England, 2001). Kongar and Memiş (2017) directed their attention towards gender gap disparities in the division of paid and unpaid work as children age, utilizing data from the 2006 Turkish Time-Use Survey. However, this study does not consider dimensions such as education, race, and employment status when analyzing disparities in time use – a gap that this study aims to address. Consequently, this study not only updates but also augments and fortifies the findings of existing studies.

This study further enhances and extends the findings of the study focusing on time use across an individual's life cycle. Most existing studies on the disparities in time spent on market work, domestic activities, and leisure over an individual's life cycle have primarily concentrated on gender-based differences (Aguiar et al., 2012; Anxo et al., 2011; Anxo et al., 2007; Apps & Rees, 2005; Apps, 2002; Apps & Rees, 2004; Anxo & Boulin, 2006). By contrast, this study contributes to the existing body of literature by analyzing variations in time use based on race, educational attainment, and employment status across an individual's life course, a dimension that has received relatively limited attention. Furthermore, it examines gender-related disparities in the context of educational levels over the course of an individual's life.

It is worth noting that there are several studies that focus on time-use patterns and heterogeneity based on employment status. However, studies that do concentrate on employment typically compare only the employed and unemployed (Hoang & Knabe, 2021; Colella & Van Soest, 2013; Krueger & Mueller, 2012; Chadi & Hetschko, 2017). Meanwhile, some studies consider employment status and gender (Floro & Komatsu, 2011), as well as the employment and children status (Budig & England, 2001). Nevertheless, they often overlook distinctions related to race and education among employed and unemployed.

This study uses data from American Time Use Survey (ATUS) spanning from 2003 to 2021. Based on descriptive graphs, I unpacked the pattern and heterogeneity in time use focusing on demographic and socio-economic factors. The findings of this study reveal that the patterns and heterogeneity in time use evolve throughout the life cycle of the child and throughout the life stages of an individual. For instance, bachelor's degree (BA) holders allocate more time to work-related activities than non-BA holders, with the gap increasing as the child grows from infancy to age 17. They also allocate more time to household production in comparison to non-BA holders at nearly every life stage of a child. However, they devote less time to socializing, relaxing, and leisure compared to non-BA holders. These results align with the findings of Guryan et al. (2008), which indicated that individuals with higher education levels dedicate more time to childcare and work, and the time allocated to leisure diminishes as the level of education increases.

Across most life stages of the child, BA-holding females spend more time on work and work-related activities, compared to non-BA holder females, with the gap increasing as the child grows up. This may suggest that education could boost female labor force participation and narrow the gender gap, aligning with Ilahi's (2001) proposition. However, over their life

cycle, the difference in time allocation for work and work-related activities between BA holder and non-BA holder females is minimal, with BA-holding females allocating slightly more time to these activities in most life stages. This might imply that gender has a more significant influence than education on time allocation for work-related activities. Males with a BA allocate the highest amount of time to work and work-related activities, followed by males without a BA, across the child's life cycle as well as in most stages of an individual's life. Similarly, it is noteworthy that males, regardless of education, spend less time on household tasks compared to females throughout their lives and over the child's life cycle. Additionally, males without a BA devote the highest amount of time to socializing, relaxing, and leisure activities while BA-holding female allocate the least amount of time to these activities, across the child's life cycle as well as in most stages of an individual's life.

The rest of the study is structured as follows: First, it gives an overview of pattern and heterogeneity of time use. Second, it gives highlights on data and methodology. Third, it provides descriptive analysis results of pattern and heterogeneity in time use. Finally, it presents the conclusion of the study.

3.2. Pattern and Heterogeneity in Time Allocated to Work, Household Production and Leisure

There are numerous studies focusing on disparities and patterns of time use among individuals based on demographic, socio-economic and cultural factors. For instance, various studies show that women, on average, devote significantly more time to unpaid household labor such as household and caregiving responsibilities compared to men (Rubiano Matulevich & Viollaz, 2019; Lydeka & Tauraitė, 2020; Ilahi, 2000). These gender-based time disparities contribute to women's limited participation in the labor market and earnings inequality. Men

allocate more time to paid work and leisure (Ilahi, 2000; Lydeka & Tauraitė, 2020). Succinctly, women allocate more time to domestic and caring responsibilities than their male counterparts who spend more time doing market work (Anxo et al., 2007). These inequalities are persistent, though some changes were noted over time (Sayer, 2005).

Gender disparities in time allocation are influenced by cultural norms and economic conditions (Rubiano Matulevich & Viollaz, 2019). Gender roles strongly influence time use, affecting work-life balance and free time availability. This highlights the ongoing challenge of gender-based time inequality and its impact on women's overall well-being. Bittman et al. (2003) found that gender often plays a more significant role than income in determining the division of household work. Women tend to spend more time on household tasks, irrespective of their earnings or employment status, highlighting persistent gender inequalities. Bargaining power within relationships and traditional gender roles heavily influence the distribution of household chores. On the other hand, Gupta (2006) reveals that as women's earnings increase, they tend to reduce the time spent on housework. This suggests a link between economic independence and a reduction in traditional gender-based division of household responsibilities. Moreover, Syrda (2023) suggest that as spousal income gaps narrow, men tend to contribute more to housework.

Dinkelman and Ngai (2022) found that as economies shift and modernize, women often increase their participation in market work. However, gender disparities persist, with women still devoting significantly more time to unpaid household and care work compared to men, even as economies evolve. Similarly, Bridgman et al. (2018) finds that as economies undergo structural transformation and transition towards market-oriented systems, there is a significant shift away from household production. This is particularly evident in countries with higher

income levels. Agénor and Agénor (2023) explore the link between infrastructure access and women's time allocation. They find that improved infrastructure positively influences women's participation in the workforce, reduces the time spent on household chores, and enhances their engagement in leisure activities. This research highlights that increased access to infrastructure can contribute to both economic growth and gender equality, as women can allocate more time to productive activities and personal well-being.

Several studies have documented trends in the allocation of time. For instance, Aguiar et al. (2012), reveals that over the past few decades, there has been a significant rise in leisure time for both men and women. They highlight changing gender roles, with women spending more time on work, education, and leisure, while men participate more in household and childcare activities. Similarly, Coverman and Sheley (1986) indicated that men's contributions in domestic activities remained relatively modest despite an increase in men's participation in household activities over the decade. In addition, Aguiar and Hurst (2007) found a decrease in working time and an increase in leisure time for both men and women over time. Women's leisure time is increasing at the same time as their home production time is decreasing. While both men and women experienced an increase in leisure, gender differences persisted.

On the other hand, several other studies documented the patterns of time use over the course of life cycle of an individual. For instance, Apps and Rees (2005) and Apps (2002) reveal significant gender disparities in time allocated to paid work, domestic activities, and leisure across the life cycle. Similarly, Apps and Rees (2004) highlights that individuals tend to devote more time to work and less to leisure in their prime working years. As people age, they shift towards increased leisure and reduced work hours, aiming to optimize lifetime consumption. Anxo and Boulin (2006) findings reveal shifts in time use patterns, with an

emphasis on increased participation in the labor force by women across the life course. The study highlights that over the years, more time is devoted to education and, later in life, to leisure activities. However, gender-based differences persist in household and leisure time.

Kongar and Memiş (2017) revealed that gender disparities in time allocation between men and women persist across different life stages and women's time spent on household tasks peaks during child-rearing years. Moreover, despite some shifts in gender roles and higher education levels among women, traditional divisions of labor persist. Anxo et al. (2011) find persistent gender disparities in time allocation, with women dedicating more hours to unpaid household and care work throughout their lives. These discrepancies are particularly notable during child-rearing years. Additionally, Anxo et al. (2007), claim that unlike the large gender disparity in paid and unpaid work, gender disparity in the time allocated to leisure activities is much smaller and varies less over the lifecycle. The study reveals that, institutional factors such as family regulations and employment regimes impact gender division of labor.

There also exists disparity in time use based on employment status. Unemployed individuals allocate a greater proportion of their time to household and leisure activities in contrast to their employed counterparts, who dedicate more time to work and work-related activities (Hoang & Knabe, 2021; Krueger & Mueller, 2012). Chadi and Hetschko (2017), find that individuals experiencing involuntary unemployment often use their increased leisure time for activities that have intrinsic value, such as pursuing hobbies, spending time with family, or improving their health. This suggests that there may be non-monetary benefits to unemployment, challenging the traditional view that it is solely detrimental. Similarly, Burda and Hamermesh (2010), found that when individuals experience unemployment, they tend to dedicate more time to household production activities. Floro and Komatsu (2011) reveals that,

despite minimal differences in the extent of unpaid work undertaken by women and men across different employment statuses, these responsibilities have a discernible impact on women's employment choices and their capacity to actively seek remunerated employment. Furthermore, female participation in the labor force reduces their household work but not significantly (Ilahi, 2001).

Apps and Rees (2005) claim that having pre-school children affects leisure and work time of adult household members. Unlike the male members, female members of the household face the significant decline in time allotted for labor. Rubiano Matulevich and Viollaz (2019) show that marriage has a slightly stronger impact on the time dedicated by women in their prime working years to market work and personal care. Marriage or cohabitation is linked to reduction in the time men allocate to market work and personal care. When compared to their younger counterparts, the marriage penalty on time use is lower for older women and men. Combining paid work with motherhood is more challenging for women and due to that they typically reduce the time devoted to market work or even quit their jobs (Blossfeld & Drobnic, 2001). That is, parenthood often results in a manifestation of gender roles, with women dedicating more time to housework and childcare, and men spending less time on leisure activities.

Craig and Mullan (2010) reveals that parenthood significantly impacts time allocation, with mothers dedicating more time to childcare and domestic work. Kongar and Memiş (2017) ascertain that substantial disparities exist in the gender division of both paid and unpaid work across various life stages. Notably, the gender gap in paid and unpaid work is smaller among parents of older children and couples without children compared to parents of infants. Similarly, Syrda (2023) suggest that parenthood amplifies gendered roles, with women increasing their

domestic labor. Furthermore, adherence to traditional gender norms reinforces these dynamics. Bianchi (2000) found that maternal employment has increased, but time devoted to children by working mothers remains relatively stable. Fathers' involvement in child-rearing has grown, however.

Budig and England (2001) found that mothers in the United States experience a notable wage penalty in comparison to women without children, which is not entirely explained by differences in education, work experience, or hours worked. This penalty is particularly pronounced for mothers with more children and mothers who take time off work to care for their children. Craig (2007) findings challenge the idea that men are significantly increasing their contributions to housework, indicating that women continue to shoulder a disproportionate burden. Grinza et al. (2017) reveals that the transition to parenthood tends to reinforce traditional gender roles, with mothers becoming more conservative in their attitudes towards women's employment. In contrast, fathers' attitudes remain largely unchanged.

There is limited literature available that comprehensively analyzes the patterns and heterogeneity in time allocation for market work, household production, and leisure, considering dimensions such as race, employment status, and education. Most studies have primarily concentrated on examining these patterns across different life stages of individuals, with little emphasis on the role of the child's life cycle. While some studies have documented the patterns across an individual’s life cycle, minimal attention has been given to the influence of factors such as race, employment status, and education. Studies that do focus on employment tend to compare only the employed and unemployed, often overlooking the distinctions related to race and education among these groups. The present study aims to bridge these gaps by conducting a comprehensive analysis that considers the above-mentioned issues.

3.3. Data and Methodology

This study employed the American Time Use Survey (ATUS) data. ATUS data was gathered by a computer-assisted telephone interview in which the respondent describes every activity they participated in, how much time they spent on it, and with whom they spent it. These data are repeated cross-sections covering the period of 2003-2021. Each wave is based on 24-hour time diaries in which respondents provide detailed time interval descriptions of the activities they engaged in the previous day. The ATUS data are structured in such a way that every minute of the respondent's day can be accounted for. The survey involves a random selection of eligible individuals from each household in the selected sample of households. Notably, a civilian household member who is at least 15 years old is considered eligible for this survey. It is also worth noting that every eligible individual in a sample household has an equal probability of being selected to participate in the ATUS.

This study is primarily focusing on a descriptive analysis of time use trends and patterns. It does not attempt to establish causal relationships or make predictions. Visual representations, in the form of graphs, have been utilized for data analysis to enhance the clarity of patterns and trends. To enhance the depth of the analysis, various categorizations and groupings have been employed to examine distinctions among different subgroups or data categories. For instance, the data has been categorized based on gender, allowing for comparisons of variations in time allocation for work, household production, and leisure activities in relation to educational levels. This descriptive analysis holds significance in providing insights into the subject of time use, thereby laying the foundation for more extensive research, and supporting decision-making processes. The statistical summary of the variables used to assess the pattern and heterogeneity of time allocation is presented in Appendix Table A 3.1.

3.4. Descriptive Analysis Results

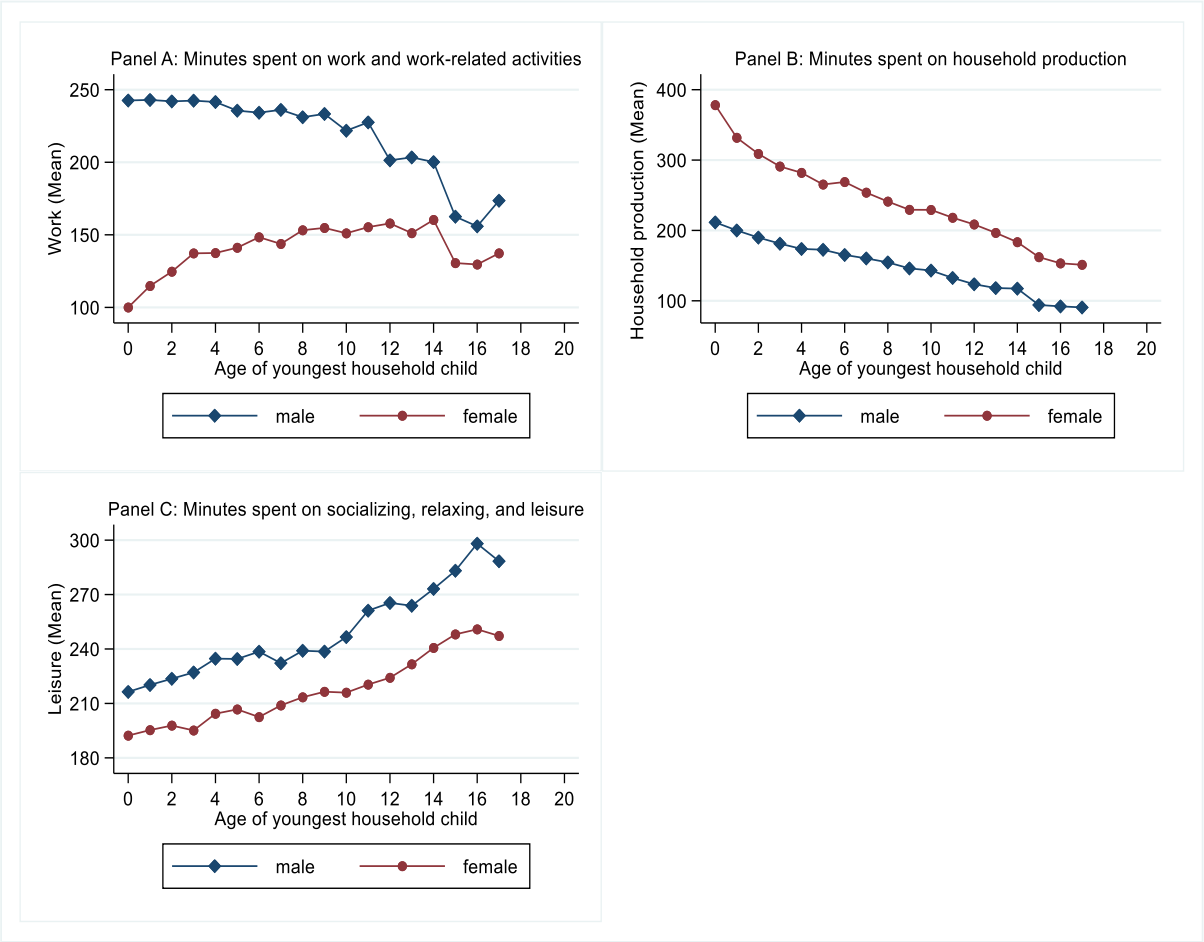
The objective of this section is to conduct a comprehensive analysis of time use across various demographic and socio-economic categories. Specifically, I examine disparities in time use among distinct groups, including employed and unemployed individuals, males, and females, as well as racial and education categories. Furthermore, I investigate nuanced comparisons, such as the examination of gender-based differences among individuals with bachelor's degrees or more and those without. Likewise, I investigate patterns of time use across the life cycle of the child, and over the life cycle of an individual.

3.4.1. Pattern and Heterogeneity in Time use Over the Life Cycle of the Child

Time Use Over Child's Life Cycle Based on Gender

The pattern depicted in Figure 3.1 reveals disparities in time allocation between males and females over the course of a child's life within a household. In terms of time dedicated to work and work-related activities, when the child is an infant (aged zero), males spend more than twice as much time as females. This disparity gradually decreases as the child grows, becoming notably smaller between ages 12 and 17. With respect to time spent on household production activities, females devote almost twice as much time as males. Nevertheless, this gender gap diminishes as the child matures, although it remains present throughout the entire life cycle of the child. The allocation of time for socializing, relaxation, and leisure activities exhibits a slightly different pattern. The gender gap is minimal when the child is an infant, but it expands to a small extent as the child grows, particularly at ages 11, 12, and 16. In general, the time allocated to socializing, relaxation, and leisure activities increases for both males and females as the child matures, with males consistently dedicating more time to these activities throughout the entire life cycle of the child.

Figure 3. 1: Time Use Over Child's Life Cycle Based on Gender



Time Use Over Child's Life Cycle Based on Employment Status

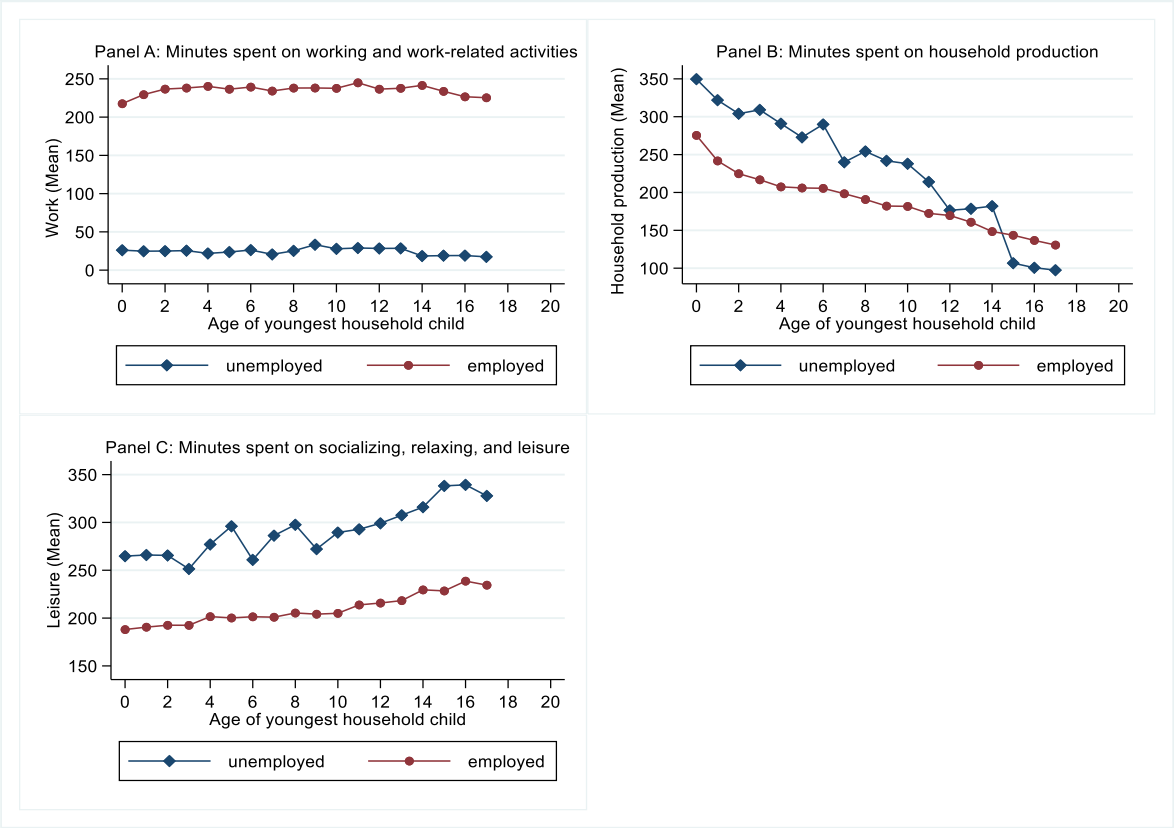
Figure 3.2 illustrates the pattern and disparity in time allocation between employed and unemployed individuals across various life stages of a child. The divergence in time allocation between employed and unemployed individuals for work and work-related activities remains relatively consistent throughout the child's life cycle. Employed individuals consistently dedicate approximately seven times more time to these activities compared to their unemployed counterparts. In this context, working and work-related activities encompass the allocation of time dedicated to employment, tasks associated with one's occupation, involvement in revenue-

generating pursuits (outside of formal employment), and the pursuit of employment opportunities through job searches and interviews.

Regarding household production activities, unemployed individuals invest about 75 more minutes than employed individuals when the child is at infancy (aged zero). This gap increases slightly at ages 3 and 6 but becomes minimal at ages 7, 11, 13, and 14. Interestingly, at the age of 12, there is virtually no gap in time allocation for household production activities between employed and unemployed individuals. However, from ages 15 to 17, a reversal occurs, with unemployed individuals spending less time on household activities compared to their employed counterparts. In general, both employed and unemployed individuals allocate less time to household production activities as the child matures.

In terms of socializing, relaxing, and leisure activities, unemployed individuals allocate approximately 70 more minutes than employed individuals when the child is an infant (aged zero), but this difference increases to approximately 85 more minutes than employed individuals when the child is 17 years old. This suggests that, in general, the gap in time allocation slightly widens as the child grows older. The disparity is relatively small at ages 3 and 6 but slightly larger at ages 5, 8, 15, and 16. In general, time allocated to socializing, relaxing, and leisure increases for both employed and unemployed individuals as the child grows.

Figure 3. 2: Time Use Over Child's Life Cycle Based on Employment Status



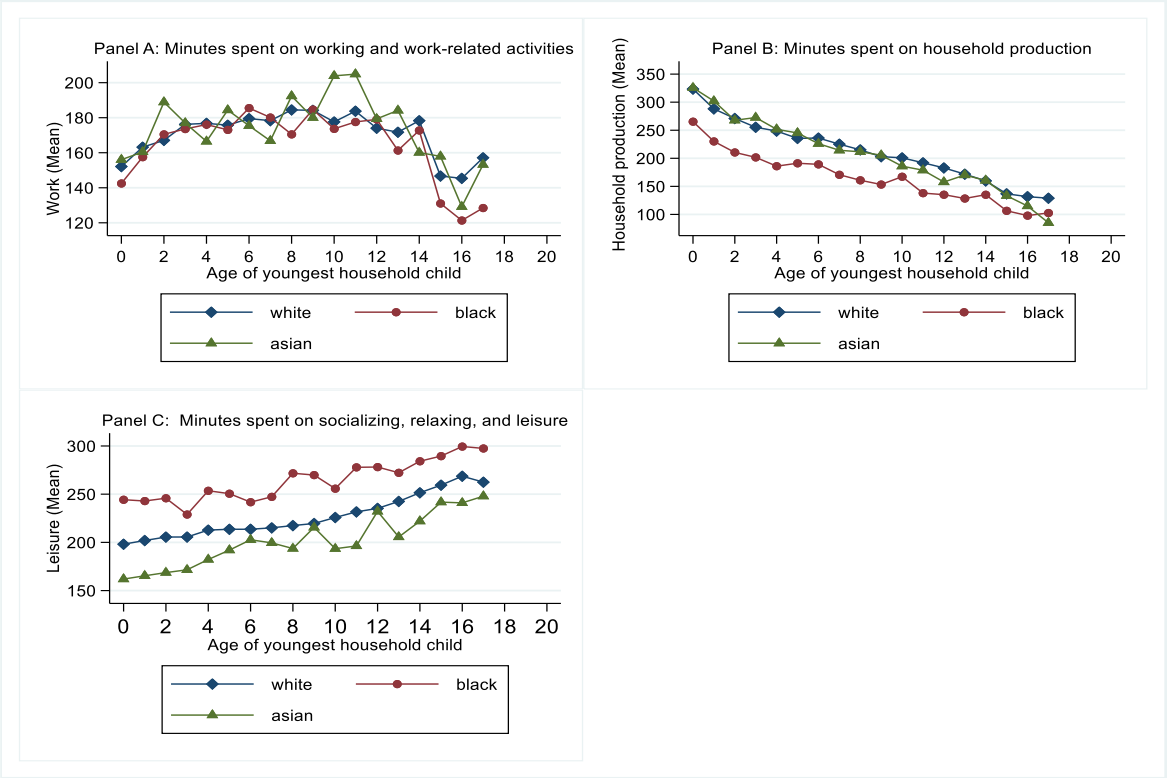
Time Use Over Child's Life Cycle Based on Race

Figure 3.3 illustrates the time utilization patterns based on an individual's race. The pattern exhibits an inverted U-shape for individuals of Black, White, and Asian ethnicities. When the child is aged zero, there are almost no discernible differences in time allocation for work and work-related activities between whites and Asians, while Blacks allocate less time than both groups. From ages 1 to 5, and again at ages 7 and 10, there is virtually no significant difference in time allocation for work and work-related activities between Black and White individuals. By age 9, there is almost no discernible time use gap among the three racial groups (White, Black, and Asian). However, a slight discrepancy emerges at ages 2, 10, and 11, where Asians allocate more time to these activities compared to their Black and white counterparts.

At age 17, Asians and white individuals spend more time on these activities compared to Black individuals and the gap is larger than the initial gap.

Furthermore, the time allocated to household production activities diminishes as the child matures for individuals of Black, White, and Asian ethnicities. When the child is at age zero, there is no disparity between Asians and whites; however, at age 17, a more noticeable disparity emerges, with white individuals allocating more time to household production. Blacks consistently spend less time on household production activities across the child's life cycle compared to whites and Asians, except at age 17, where the gap reverses, and Asians instead spend less time on household activities compared to Whites and Blacks. Additionally, throughout the child's life cycle, Black individuals allocate more time to socializing, relaxing, and leisure activities compared to their Asian and White counterparts. Conversely, Asians allocate less time to these activities than Black and White individuals, except at ages 9 and 12, when there is almost no discernible time use gap for these activities between White and Asian individuals. In general, the time spent on these activities increases as the child matures for individuals of Black, White, and Asian ethnicities.

Figure 3. 3: Time Use Over Child's Life Cycle Based on Race



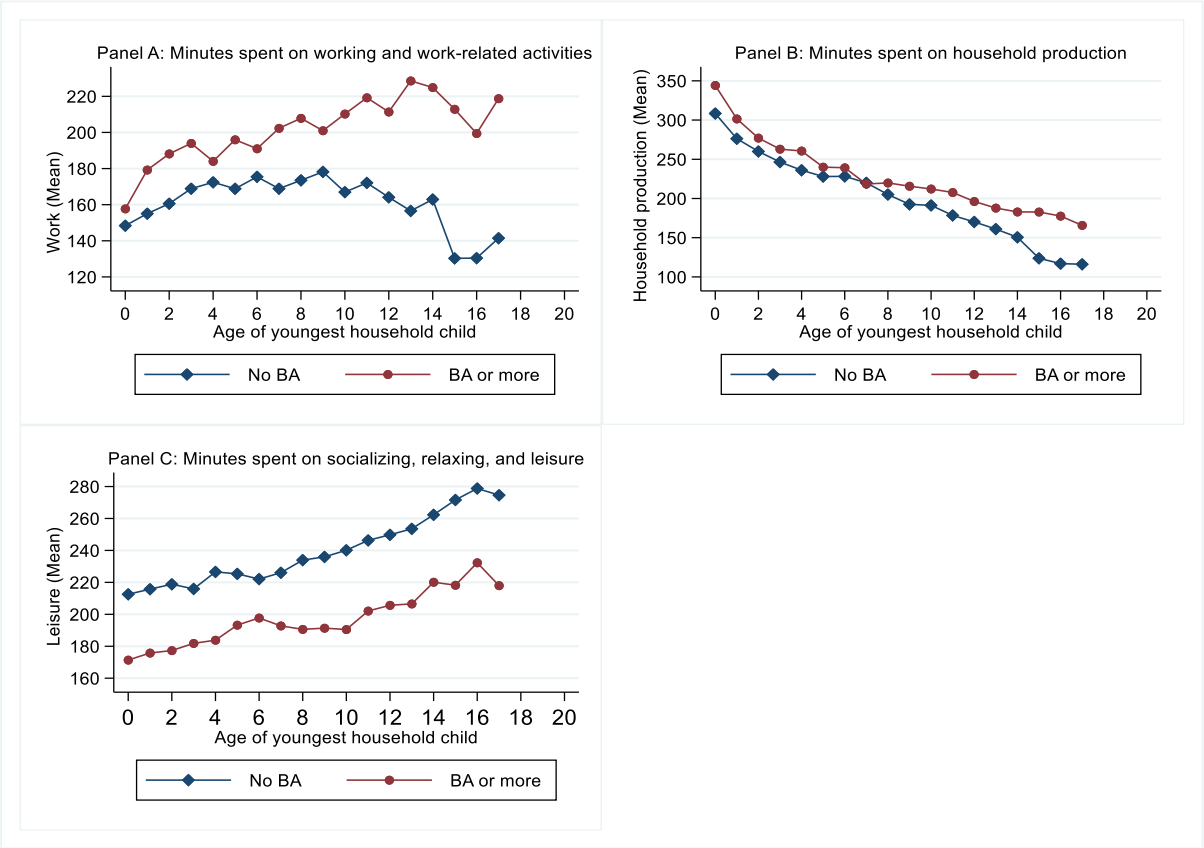
Time Use Over Child's Life Cycle Based on Education

Figure 3.4 illustrates the time utilization patterns based on educational attainment. It presents a comparative analysis of time allocation between individuals holding a bachelor's degree or higher (referred to as individuals with BA) and those without a bachelor's degree (referred to as individuals with no BA). During the infancy stage of the child, the disparity in time allocation for work and work-related activities between individuals with BA and those without BA is relatively minor. Individuals with BA spend approximately 10 minutes more on work and work-related activities compared to their counterparts without BA during the infancy stage of the child. As the child grows older, this gap in time allocation for work-related activities widens. For instance, when the child reaches the age of 17, individuals with BA spend approximately 80 minutes more on these activities compared to those without BA.

Concerning time spent on household production activities, individuals with BA allocate roughly 30 more minutes to these activities when the child is at age zero, but this gap gradually diminishes and disappears completely when the child turns seven (7). However, after the age of seven (7), this gap starts to widen again and persists until the child reaches 17 years of age, with individuals holding a BA dedicating more time to household production activities. In general, the time dedicated to household production activities decreases over the course of the child's life cycle, but the gap between individuals with and without BA remains. It is noteworthy that the disparity at age 17 is relatively more pronounced (i.e., individuals with a BA spend an additional 50 minutes on household production activities) than the initial gap, which amounts to an extra 30 minutes.

Furthermore, when the child is an infant (age zero), individuals without a BA spend approximately 40 minutes more on socializing, relaxing, and leisure activities compared to their counterparts holding a BA. However, this gap becomes larger as the child reaches the age of 17, with individuals lacking a BA spending roughly 55 minutes more on these activities compared to those with a BA. It is noteworthy that when the child is six years old, the gap in time allocation for socializing, relaxing, and leisure activities is smaller compared to other life stages of the child, where individuals with no BA allocate roughly 20 minutes more to these activities compared to those with a BA.

Figure 3. 4: Time Use Over Child's Life Cycle Based on Education



Time Use Over Child's Life Cycle Based on Education and Gender

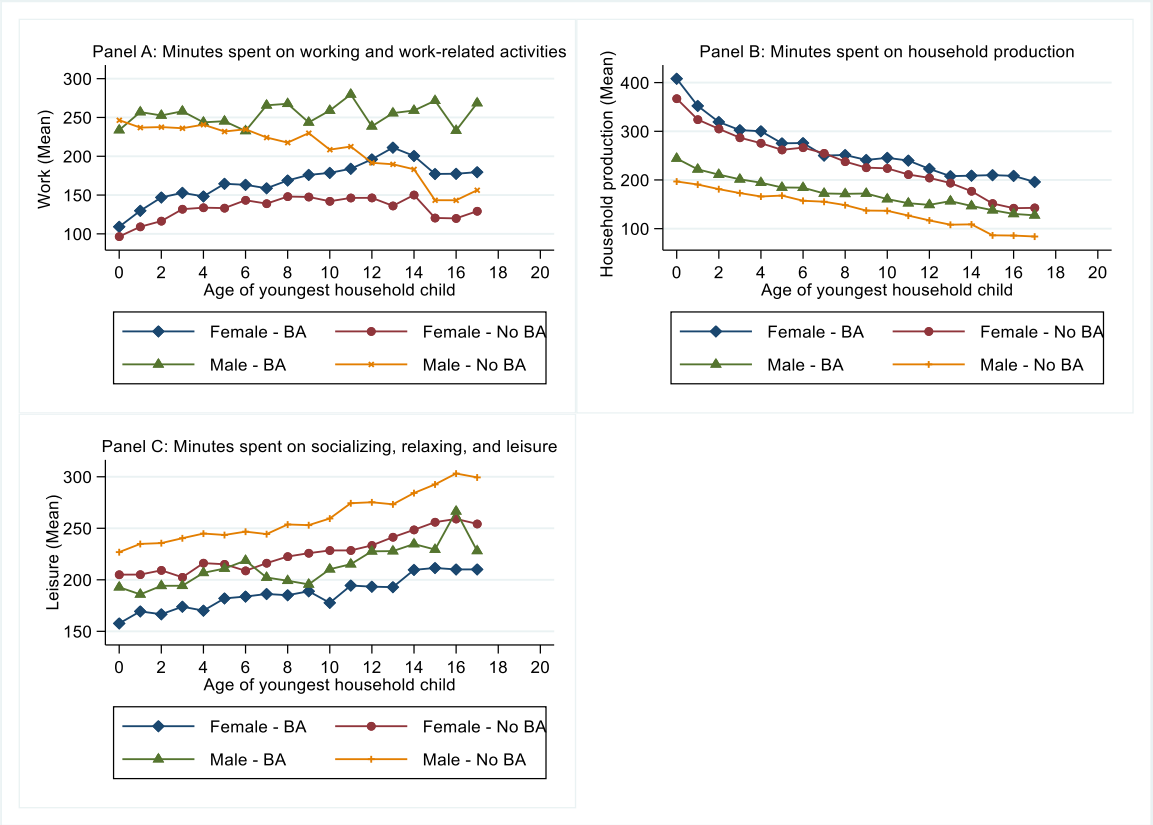
Figure 3.5 illustrates the patterns and variations in time allocation for work and work-related activities, household production, and socializing, relaxation, and leisure activities, based on education and gender. Regarding the time dedicated to work and work-related activities, it is evident that, throughout most stages of the lifecycle of children, males with a BA allocate the highest amount of time to these tasks when compared to males without a BA, as well as females with and without a BA. The time that males with a BA allocate to work and work-related activities remain generally stable throughout the child life cycle, whereas the time that males without a BA allocate to these activities decreases as the child grows. Conversely, females without a BA devote the least amount of time to work and work-related activities, in

contrast to females with a BA, as well as males with and without a BA. Noteworthy, across most life stages of the child, BA-holding female allocate more time to work and work-related activities, compared to non-BA holder women, with the gap increasing as the child grows up. This may suggest that education could boost female labor force participation and narrow the gender gap, aligning with Ilahi's (2001) proposition.

In addition, irrespective of gender and educational achievements, the time spent on household production tends to decrease as the child matures. During nearly all phases of a child's life, females with a BA allocate the highest amount of time to household production, compared to females without a BA, as well as males with and without a BA. Males without a BA dedicate the least amount of time to these activities, followed by males with a BA, throughout the child's life cycle.

Furthermore, irrespective of gender and educational attainment, the amount of time dedicated to socializing, relaxation, and leisure typically rises as the child matures. Males without a BA allocate the highest amount of time to socializing, relaxation, and leisure, surpassing both their counterparts with a BA and females, both with and without a BA. Conversely, females with a BA allocate the smallest amount of time to socializing, relaxation, and leisure, in comparison to females without a BA and to males, both with and without a BA.

Figure 3. 5: Time Use Over Child's Life Cycle Based on Education Level and Gender



3.4.2. Patterns and Heterogeneity in Time Use Over the Life Cycle of an Individual

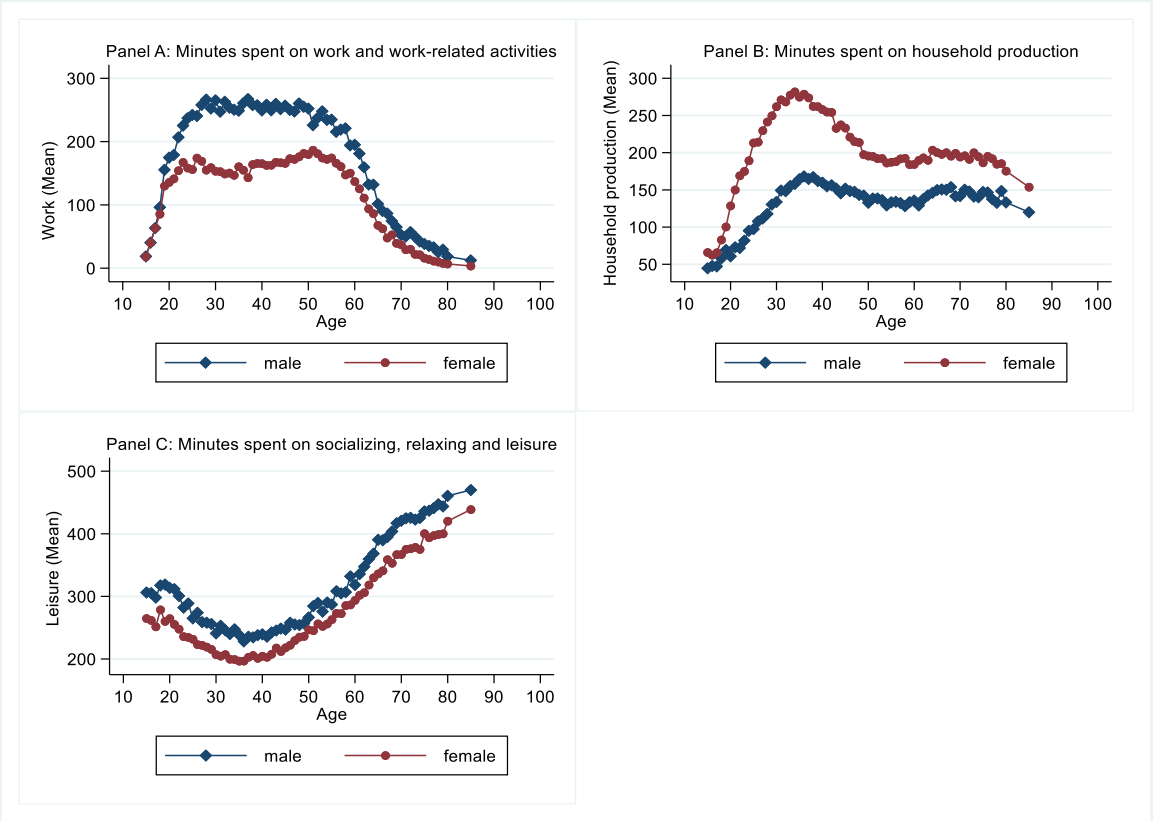
Time Use Over the Life Cycle of an Individual Based on Gender

Figure 3.6 illustrates the pattern of time allocation across the lifespan for both male and female individuals. Notably, during the age range of 15 to 18 years, there is no discernible disparity in the allocation of time to work and work-related activities between males and females. However, a noticeable gap emerges in favor of males at age 19, reaching its peak at age 35, and then gradually declining. From age 62 to 85, the disparity becomes minimal, and by age 85, it is virtually nonexistent. This phenomenon can be attributed to the life stage when individuals in the United States typically commence retirement from their employment. In general, the gender disparity in work and work-related activities becomes most pronounced

between the ages of 25 and 50, with males consistently allocating more time to these activities. The observed pattern of time allocated to work and work-related activities take on an inverted U-shape for both genders.

Conversely, in terms of time allocated to household production activities, the gender gap is minimal from ages 15 to 17, with males dedicating slightly less time to these tasks. However, the gap becomes increasingly apparent and widens further in favor of males from age 18, reaching its zenith at age 35. After age 35, the disparity in time allocated to household production activities gradually diminishes but persists until the age of 85. Across all life stages, males consistently allocate less time to household production activities. Much like work activities, the pattern for household production activities demonstrates an inverted U-shape for both male and female individuals. In contrast to market work and household production activities, the pattern for socializing, relaxing, and leisure activities follows a U-shape trajectory. The time allocated to these activities gradually decreases, reaching its lowest point at age 35. After age 35, the time allocated to these activities begins to increase again, continuing until both males and females reach the age of 85. It is noteworthy that males consistently allocate more time to these activities across all life stages.

Figure 3. 6: Time Allocation Across the Lifespan of an Individual Based on Gender



Time Use Over the Life Cycle of an Individual Based on Employment Status

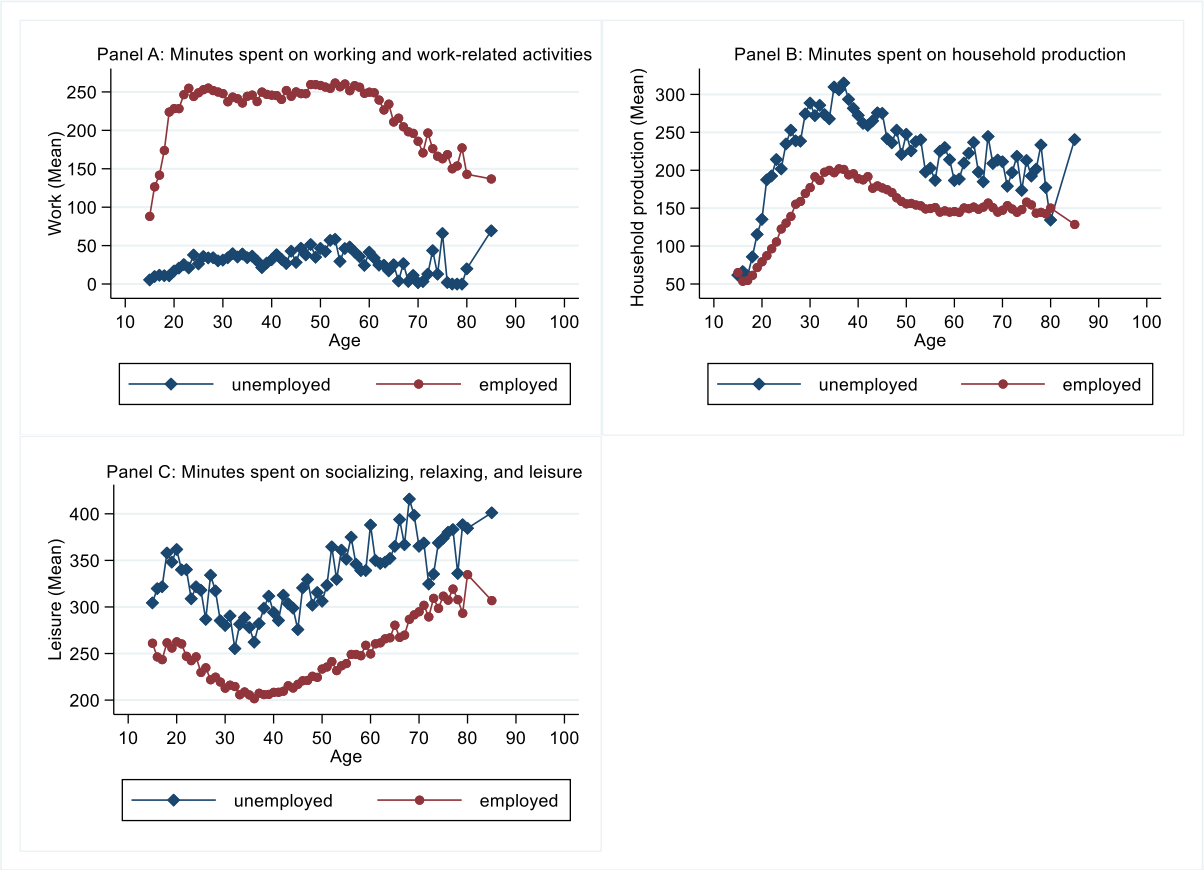
Figure 3.7 illustrates the patterns of time allocation between employed and unemployed individuals across their lifespan. Across all life stages, those who are employed consistently dedicate more time to work and work-related activities when compared to their unemployed counterparts. The disparity is relatively modest at age 15 but becomes most pronounced between the ages of 23 and 60. Beyond the age of 60, the gap begins to diminish and eventually resembles the initial difference. In a general sense, both employed and unemployed individuals exhibit a pattern characterized by an inverted U-shape.

Throughout all life stages, with the exceptions of ages 15 to 17 and 80, unemployed individuals dedicate more time to household production activities than their employed

counterparts. Notably, during the period from ages 15 to 17, both unemployed and employed individuals dedicate roughly the same amount of time to household production activities. The dissimilarity becomes more evident starting at the age of 18, reaching its zenith at age 35, which represents the peak allocation of time for both employed and unemployed individuals to household production activities. Subsequently, after age 35, the gap begins to narrow and slightly reverses at age 80, where unemployed individuals allocate marginally less time to household production activities compared to their employed counterparts. Nonetheless, beyond age 80, the gap resumes an upward trajectory until age 85, when it mirrors the disparity observed at age 35. The time allocation patterns for household production activities over the lifespan of both employed and unemployed individuals follow an inverted U-shaped trajectory.

In contrast, the time utilization patterns for socializing, relaxation, and leisure activities for both employed and unemployed individuals trace a U-shaped trajectory. Unemployed individuals devote more time to socializing, relaxing, and leisure activities than their employed counterparts in all stages of life. Age 35 (more prominently observed among the employed) appears to be the age at which both employed and unemployed individuals allocate the least amount of time to socializing, relaxing, and leisure. The gap at age 85 is larger than the initial gap observed at age 15. Initially, this gap is roughly 40 minutes, but by age 85, it increases to over 90 minutes, with unemployed individuals allocating more time to these activities compared to the employed.

Figure 3. 7: Time Allocation Across the Lifespan Based on Employment Status



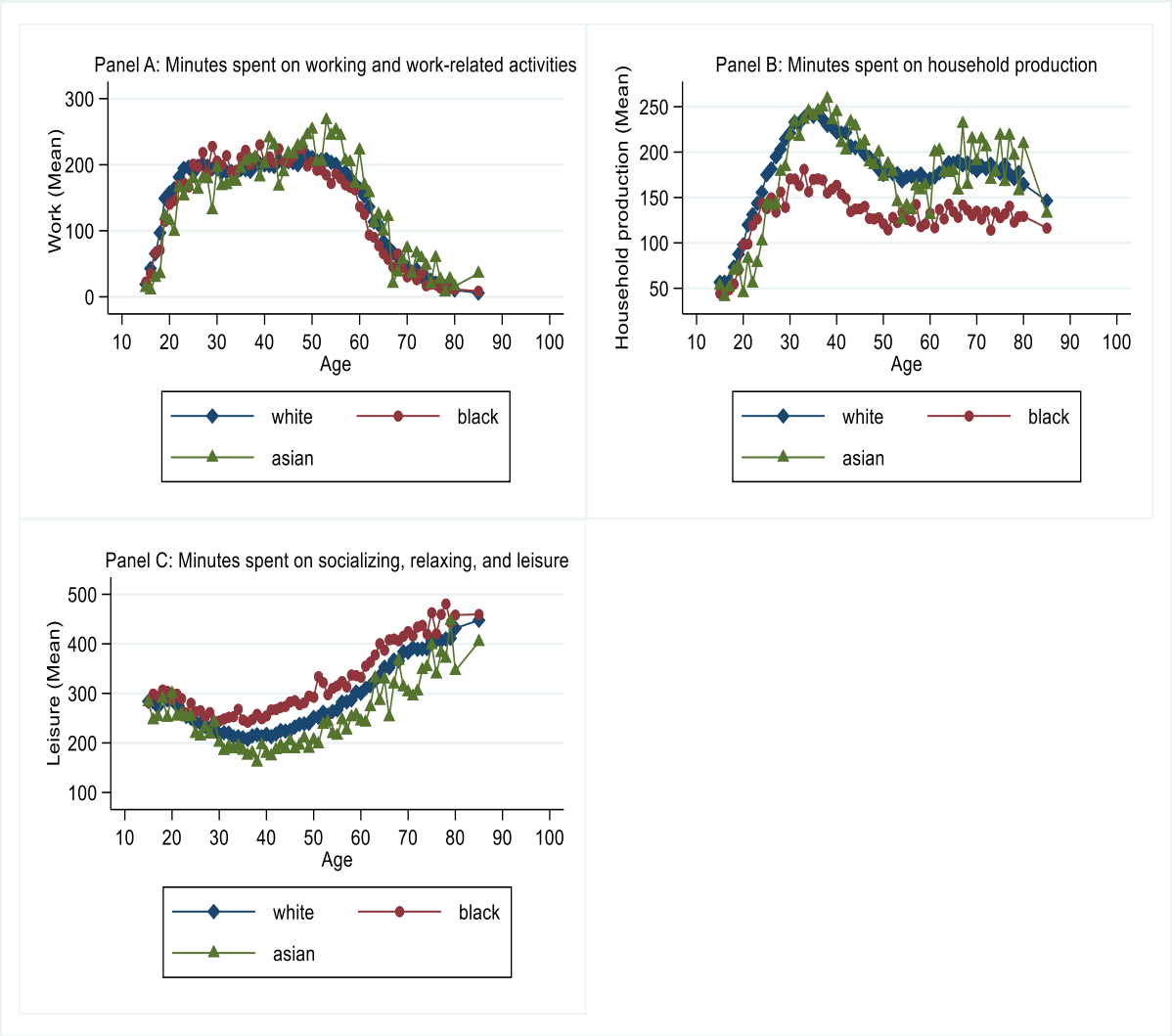
Time Use Over the Life Cycle of an Individual Based on Race

Figure 3.8 illustrates the time utilization patterns among individuals of White, Black, and Asian ethnicities. Concerning the allocation of time to work and work-related activities, all three ethnic groups exhibit an inverted U-shape pattern over the course of their lives. Broadly, there exists a minimal disparity in time allocation for work and work-related activities between Black and White individuals across their life course. While the time Asians allocate to work and work-related activities fluctuate considerably throughout their life cycle, the difference between Asians and their counterparts (i.e., Black, and White individuals) remains relatively small during most life stages.

Additionally, the pattern of time allocation for household production activities also exhibits an inverted U-shaped trend across the life course of these groups. From ages 15 to 24, there is no noticeable distinction in time dedicated to household production activities between White and Black individuals. However, past the age of 24, a discernible gap emerges, with White individuals allocating more time to household production activities compared to Black individuals. This gap peaks at age 35, marking the stage where White individuals allocate the most time to household production activities. Black individuals, on the other hand, allocate the greatest amount of time to these activities around age 33. Beyond age 33 for Blacks and age 35 for Whites, the time allocated to these activities diminishes, but the gap persists until the age of 85. From ages 15 to 19, the time Asians allocate to these activities is almost identical to the time Whites and Blacks spend on them. At age 38, Asians allocate more time to these activities compared to other life stages. During most life stages beyond age 24, Blacks allocate less time to these activities compared to Whites and Asians.

Furthermore, the time allocation pattern for socializing, relaxing, and leisure activities follows a U-shaped trajectory for Blacks, Whites, and Asians. The gap between Whites and Blacks is insignificant from age 15 to 30 but slightly emerges beyond the age of 30, where Blacks spend more time on these activities than Whites. However, this gap diminishes almost entirely by age 85. In contrast, beyond the age of 30, the gap between Blacks and Asians is slightly more pronounced compared to the gap between Blacks and Whites, with Black individuals dedicating more time to these activities.

Figure 3. 8: Time Allocation Across the Lifespan of an Individual Based on Race

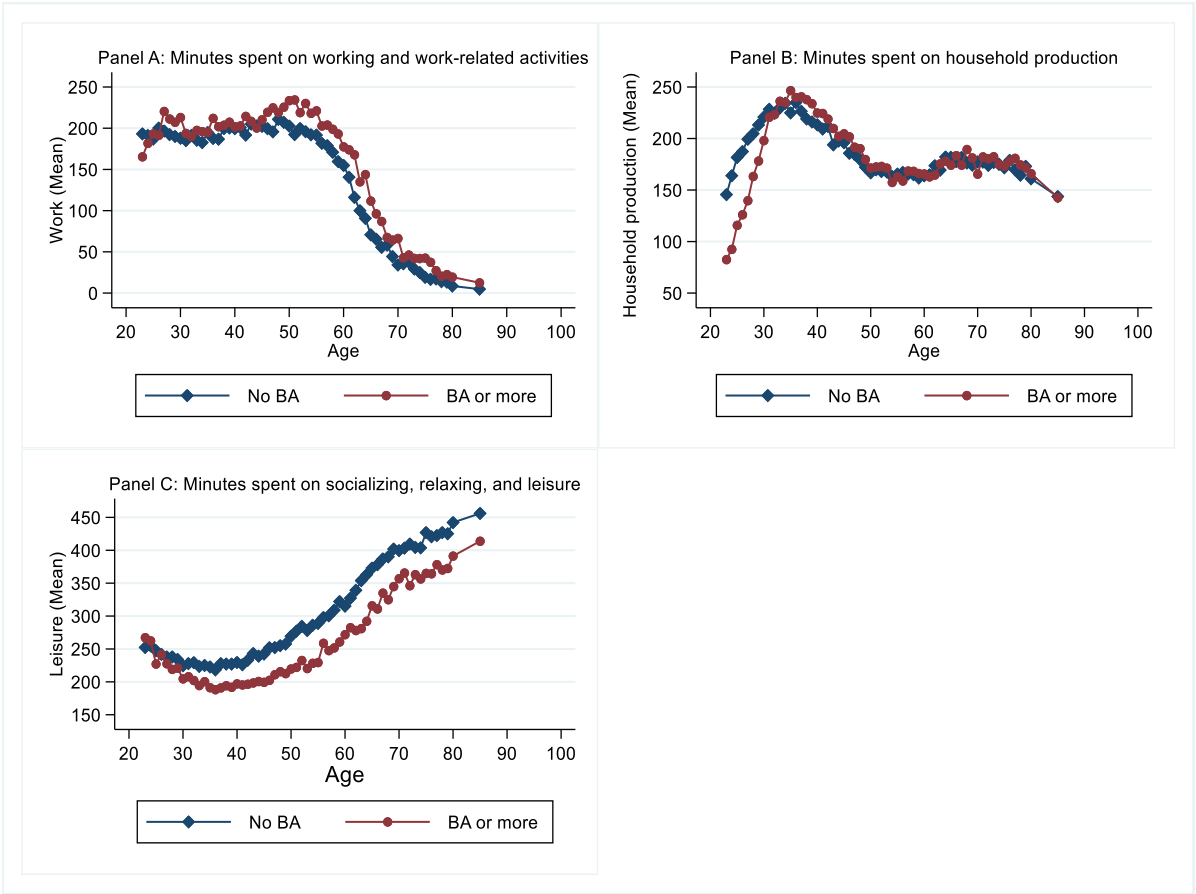


Time Use Over the Life Cycle of an Individual Based on Education

Figure 3.9 depicts the time utilization patterns among individuals with a bachelor's degree or higher (BA) and those without a BA. The time allocated to work and work-related activities by both groups follows an inverted U-shape. In most stages of life, BA holders allocate slightly more time to these activities compared to their non-BA counterparts. At the age of 85, there is nearly no disparity between individuals with and without a BA.

In terms of time spent on household production activities, up to around the age of 29, individuals without a BA generally allocate more time to these activities, and the disparity is noticeable. However, from the age of 30 onward to age 85, there is no significant gap in the time allocated to household production activities between those with and without a BA. Additionally, the time allocation patterns for socializing, relaxing, and leisure activities for BA and non-BA individuals exhibit a U-shaped trend. Up to the age of 30, there is no substantial disparity between individuals with and without a BA. However, beyond the age of 30, a discernible gap emerges, with individuals without a BA consistently allocating more time to socializing, relaxing, and leisure. This gap gradually increases and persists until the age of 85.

Figure 3. 9: Time Allocation Across the Lifespan of an Individual Based on Education Level



Time Use Over the Life Cycle of an Individual Based on Education and Gender

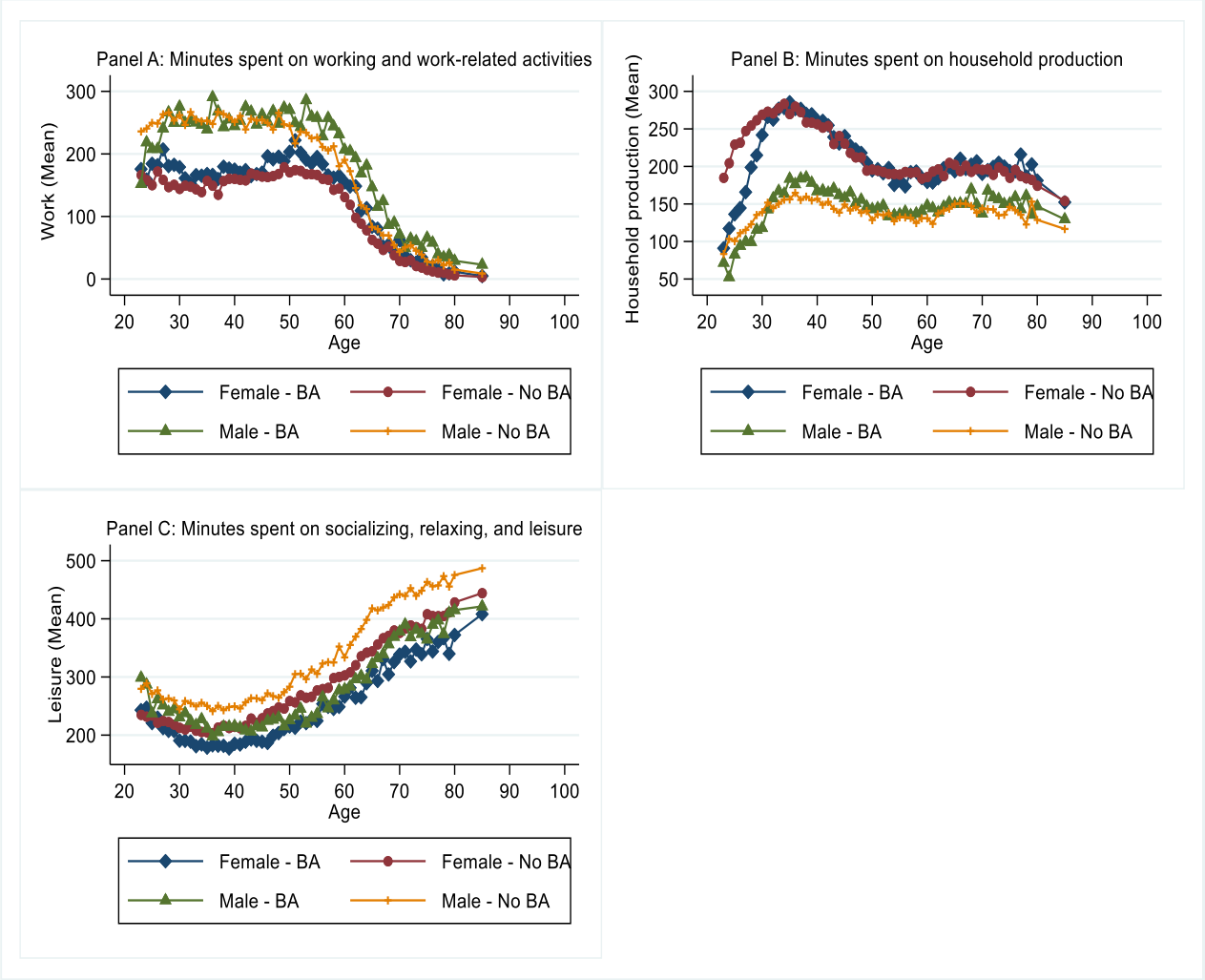
Figure 3.10 presents an analysis of time allocation for work and work-related activities, household production, and socializing, relaxing, and leisure, considering gender and education. In most stages of life, males with a BA allocate the most time to work-related activities, followed by males without a BA. Females without a BA allocate the least time to these activities, with females holding a BA coming next. In other words, a minimal disparity exists between females with and without a BA, with females holding a BA allocating slightly more time at most life stages. This observation may indicate that education could slightly increase female labor force participation and slightly reduce the gender gap across different life stages, as suggested by Ilahi (2001). However, it could also imply that gender exerts a more substantial influence on time allocation for work-related activities than education. Notably, these gaps diminish after the age of 50, and by age 85, there are no noticeable differences among females with or without a BA and males without a BA. At age 85, the gap between males with a BA and the other groups (females with and without a BA, and males without a BA) is negligible. This suggests that, over time, gender disparities in time allocation for work-related activities tend to decrease, and the influence of education becomes less pronounced in later life stages.

Up to the age of 29, females without a BA allocate more time to household production activities than females with a BA, as well as both males with and without BA. However, from age 30 onwards, there is no significant difference in the time allocated to household work between females with and without a BA in most life stages, and by age 85, there's no difference at all. This suggests that gender may have a more pronounced influence than education in determining the time spent on household tasks. In contrast, males without a BA spend the least amount of time on these activities, followed by males with a BA, but the gap between them remains minimal across various life stages. Generally, there is no substantial difference

between males with and without a BA and females with and without a BA in most life stages. Nevertheless, it is noteworthy that males, irrespective of their educational attainment, allocate less time to these activities in comparison to females across their lifespan. Furthermore, even after accounting for educational levels, the disparity begins to expand at approximately age 25 and gradually diminishes around age 50.

The pattern of time allocation for socializing, relaxation, and leisure activities follows a U-shaped trajectory. The time allocated to these activities increases as individuals age, irrespective of gender and educational attainment. Across most life stages, males without a BA allocate the most substantial portion of their time to these activities when compared to males with a BA and females with or without a BA. Notably, females holding a BA allocate the least amount of time to these activities compared to their counterparts without a BA and to males with or without a BA. Interestingly, beyond the age of 45 and up to 85, females without a BA tend to allocate slightly more time to socializing, relaxing, and leisure activities in comparison to males with a BA. Furthermore, at the age of 85, there is no discernible disparity in the time spent on socializing and leisure activities between males and females with a BA.

Figure 3. 10: Time Use Across Individual's Lifespan Based on Education Level and Gender



3.5. Conclusion

This paper analyzes the pattern and heterogeneity of time allocated to work and work-related activities, household production, and socializing, relaxing and leisure activities over the life cycle of the child and the life cycle of an individual. It investigates how time allocation patterns and disparities evolve over the child's life cycle as well as over the lifespan of an individual (i.e., as an individual ages).

Time allocation patterns evolve as a child grows. When a child is an infant, males tend to spend more time on work and leisure related activities, while females allocate more time to household production. The gap in work- and work-related activities and household production activities decreases as the child grows but persists throughout the child life cycle. This is consistent with the findings of Kongar and Memiş (2017) that the gender gap in market work and household production decreases as the child ages. These findings suggest that gender roles and the division of labor in households persist over time, even as children age. This may be attributed to cultural and social norms, which often dictate that women are primarily responsible for caregiving and domestic tasks (Rubiano Matulevich & Viollaz, 2019).

The gender gap in time allocation persists throughout all life stages. Men tend to spend more time on market work and leisure, while women allocate more time to domestic activities. This divide narrows with age but remains persistent, in line with Apps and Rees (2005) and Apps (2002) findings that this pattern holds across the life cycle. In contrast, the gender gap in leisure activities remains consistently small and relatively stable over one's lifetime, in line with Anxo et al.'s (2007) findings. Notably, during the years of child-rearing, women's time devoted to household tasks reaches its peak, corroborating the findings of Kongar and Memiş (2017) and Anxo et al. (2011). This underscores the ongoing challenge of gender-based time inequality and its implications for women's well-being, highlighting the enduring influence of traditional gender roles. These findings align with studies on gender roles and work division, as demonstrated by Bianchi et al. (2006), emphasizing the impact of societal expectations and evolving gender roles. Addressing these disparities in time allocation can facilitate a fairer distribution of household and caregiving duties, ultimately enhancing work-life balance for individuals of all genders.

Employed individuals consistently devote more time to work-related activities throughout both the child's life cycle and various life stages. Conversely, unemployed individuals allocate more time to household production and socializing, relaxation, and leisure activities across these life phases. This trend aligns with multiple studies (Hoang and Knabe, 2021; Krueger & Mueller, 2012) indicating that the unemployed tend to spend more time on household and leisure activities compared to their employed counterparts. It is noteworthy that unemployment may lead to heightened stress and reduced well-being, even when more time is available for leisure pursuits (Krueger & Mueller, 2012). Unemployed individuals might engage more in socializing, relaxation, and leisure to cope with the stress of unemployment or to foster social connections. The findings imply that employed individuals consistently prioritize work-related activities, potentially impacting their work-life balance. These trends have implications for work-life policies, family dynamics, and the evolving nature of daily activities during both the child's life cycle and an individual's life stages.

Time allocation patterns vary among individuals of different racial and ethnic backgrounds. Black individuals typically allocate less time to household production but invest more time in socializing, relaxing, and leisure activities in comparison to their White and Asian counterparts. This pattern holds in most stages of an individual's life and throughout the child's life cycle. This suggests the existence of racial and ethnic disparities in time allocation, which can be influenced by cultural and socioeconomic factors. It highlights the intersection of race and age of the child as well as race and age of an individual in shaping time usage. Succinctly, there are racial disparities in time allocation, particularly concerning household production and leisure, reflecting complex dynamics at play.

Individuals holding a bachelor's degree (BA) tend to devote more time to work and work-related activities, and household production, while those without a BA allocate more time to socializing, relaxing, and leisure, irrespective of the child's age. Throughout various life stages, those with a BA consistently invest slightly more time in work and household tasks compared to their non-BA counterparts, but they allocate less time to socializing, relaxation, and leisure. This suggests that higher education levels correlate with increased time dedicated to work and career-related pursuits. It underscores the influence of educational attainment on time distribution, particularly concerning work-related endeavors. BA holders may prioritize their careers, resulting in less leisure time, while non-BA individuals might have more time for socializing and relaxation. These findings align with Guryan et al.'s (2008) findings that highly educated individuals spend more time on childcare and work more, and that time spent on leisure activities tends to decrease as education levels rise.

Across most life stages of the child, BA-holding females allocate more time to work and work-related activities, compared to non-BA holder females, with the gap increasing as the child grows up. This may suggest that education could boost female labor force participation and narrow the gender gap, aligning with Ilahi's (2001) proposition. However, over their life cycle, the difference in time allocation for work and work-related activities between BA holder and non-BA holder females is minimal, with BA-holding females allocating slightly more time to these activities in most life stages. This might imply that gender has a more significant influence than education on time allocation for work-related activities. Males with a BA allocate the highest amount of time to work and work-related activities, followed by males without a BA, across the child's life cycle as well as in most stages of an individual's life.

Across the various life stages of children, females holding a BA allocate the greatest amount of time to household production, followed closely by females without a BA, whereas males without a BA allocate the least amount of time to these activities. As for the allocation of time across their lifespan, from age 30 and beyond, there's little disparity in the time devoted to household work between females with and without a BA, with no disparity by age 85. This suggests that gender may exert a more significant influence than education on household task allocation, in line with Bittman et al. (2003) suggestion. Nonetheless, it is noteworthy that males, regardless of education, spend less time on household tasks compared to females throughout their lives. Males without a BA devote the highest amount of time to socializing, relaxing, and leisure activities while BA-holding female allocate the least amount of time to these activities, across the child's life cycle as well as in most stages of an individual's life.

These findings highlight the complex interplay of various factors, including the age of the child, age of an individual, employment status, ethnicity, and educational attainment, in shaping individuals' time utilization patterns. These findings underscore the need for a nuanced understanding of time allocation within different demographic groups and life stages, as these factors can significantly impact how individuals allocate their time for work, household responsibilities, and leisure activities.

It's important to note that these findings represent averages, and that individual preferences and choices can vary significantly within each group. These differences may be influenced by various factors, including cultural norms, economic circumstances, and societal expectations. The findings of this study do not only enrich understanding of human behavior but also provide valuable insights for policymakers, employers, and individuals striving for a more balanced and productive life.

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Appendix

Table A 3.1: Statistical Summary for the Variables Used for Time Use Analysis

Variable	Obs	Mean	Std. dev.	Min	Max
Female	4,440,973	0.598284	0.490245	0	1
Employed	2,956,865	0.933949	0.248372	0	1
White	4,342,395	0.838041	0.368414	0	1
Black	4,342,395	0.125505	0.331291	0	1
Asian	4,342,395	0.036454	0.187417	0	1
BA holders	4,440,973	0.24721	0.43139	0	1
BA holder female	4,440,973	0.144499	0.351596	0	1
Non-BA holder female	4,440,973	0.453784	0.49786	0	1
BA holder male	4,440,973	0.10271	0.30358	0	1
Non-BA holder male	4,440,973	0.299006	0.457823	0	1
Age of an individual	4,440,973	47.57935	17.5913	15	85
Age of the youngest household child	2,102,311	7.273832	5.242837	0	17